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REPORT

OF

T. B. FERGUSON,

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Sectional Library

A

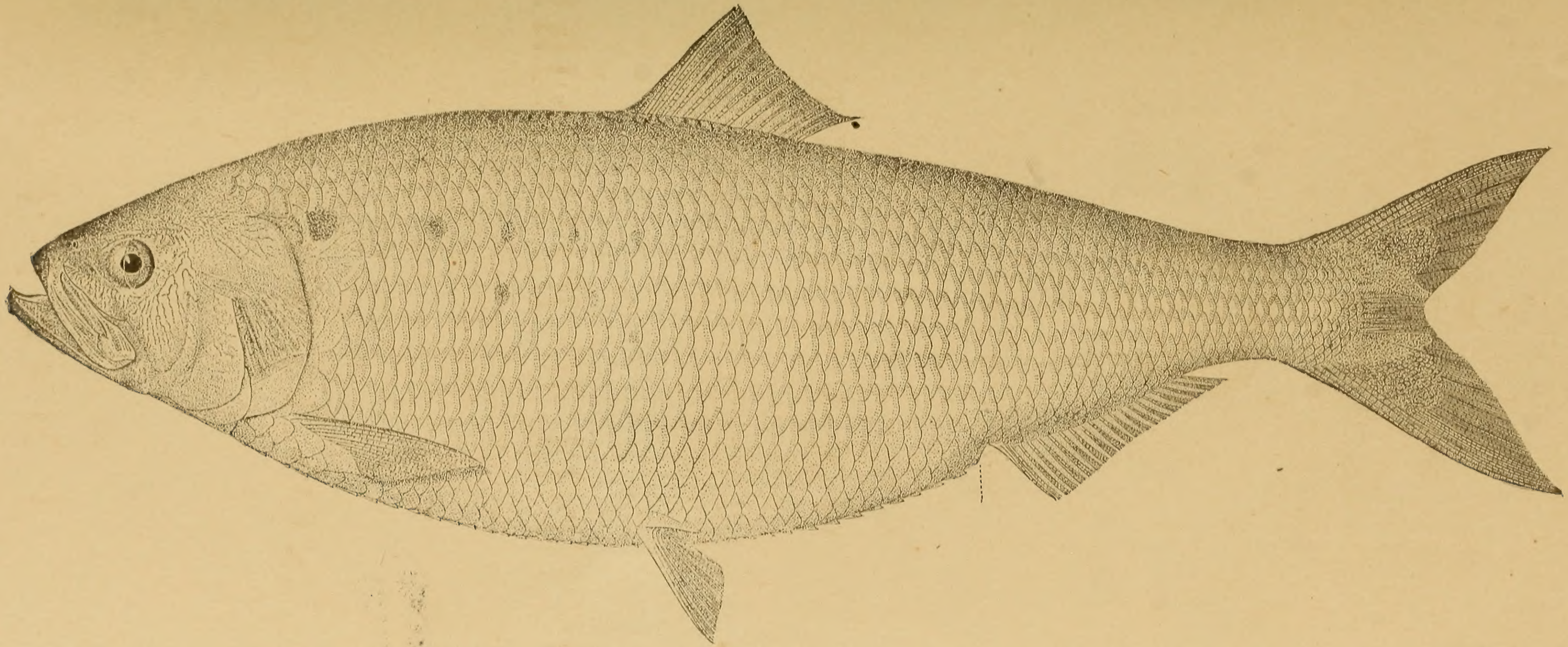
COMMISSIONER OF FISHERIES

OF

MARYLAND.

JANUARY, 1881.

HAGERSTOWN, MD.:
Bell & Co., Printers.
1881.



SHAD, (a little less than ½ natural size.) *Alosa sapidissima*, (*female.*)

H
22
3F35
881
Moll.

REPORT

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REPORT.

To his Excellency, WILLIAM T. HAMILTON,
Governor of Maryland.

The following Report contains only an account of the operations of the Maryland Commission so far as conducted under my own supervision. Chapter 150 of the laws of 1874, providing for the appointment of Commissioners of Fisheries, requires "that one of the Commissioners shall come from the Eastern, and one from the Western Shore of the State."

It was agreed, as this law seemed to direct such a course, that the details of the work of the Eastern Shore should be conducted by my colleague, and the work in the western portion of the State should be directed by myself.

To enable us each to carry on the operations in our special sections the appropriation for the year 1880–81 was equally divided between us.

The work of investigation, propagation, distribution, etc., has been conducted on as an extended a scale as the means at my command permitted. The details of these operations, including a distribution of 1,500,000 shad and 690 carp in waters wholly within the eastern section of the State, directly under my supervision, will be found in the following pages.

The young fish deposited at the head of the Bay will be as well for the benefit of the inhabitants of the one shore as for the other, for, on their return from the sea, they are taken by our citizens on either shore in the common waters.

INTRODUCTION.

The year 1880 has been a very important one in the history of the Maryland Fish Commission, not only on account of the success attained in the attempted propagation of several varieties of valuable fish by artificial means, but because of the accumulated proofs which have been afforded of the success of the effort to fully restock the waters of the State with shad.

In my Report of January, 1880, relating to the operations of the Commission during the year 1879, it was shown that there had been a very marked increase of shad for that year at those points near the head of the Chesapeake Bay and in the Potomac River, where complete records had been kept. During the Spring of 1880, this increase was even more decided, as the catch for that season not only exceeded, very largely, the returns for any one of several previous years ; but also, and in a very marked degree, the catch for 1879—the year immediately preceding.

The following figures, compiled by Col. Marshall McDonald, from returns secured from the various sources of information made available by the investigations of the Census Bureau for the Census of 1880, show most clearly the effect which the operations at the head of the Bay, and the large deposit of young shad in the Potomac River, have had upon the yield of those waters, for the catch of shad at the Head of the Bay and in the Susquehanna River from 1870 to 1871 was as follows :

In the year 1870	642,000
" " " 1871	720,000
" " " 1872	728,000
" " " 1873	516,000
" " " 1874	583,000
" " " 1875	578,000
" " " 1876	490,000
" " " 1877	464,000
" " " 1878	481,000
" " " 1879	578,000
" " " 1880	614,929
Total—11 years	6,394,929

The average catch for the eleven years, given above, we find to be 581,357; the average catch of the first five years was 637,800, and during the next five years this average was reduced to 518,200. This average, although a decrease from the average of the preceding five years, was considerably increased by the comparatively large catch of the spring of 1879—the first year that the product of artificial propagation was materially felt.

If we eliminate the catch of this year and take the average of the four preceding years—that is 1875, '76, '77 and '78—we have an average yield for those years of 402,600, but the catch of 1880 was 614,929, an increase of 33,572 over the average catch for the whole eleven years, and an increase of 96,729 over the average for the five preceding years, including the year 1879, and 212,329 over the average of the four years immediately preceding the return of the fish produced by artificial means.

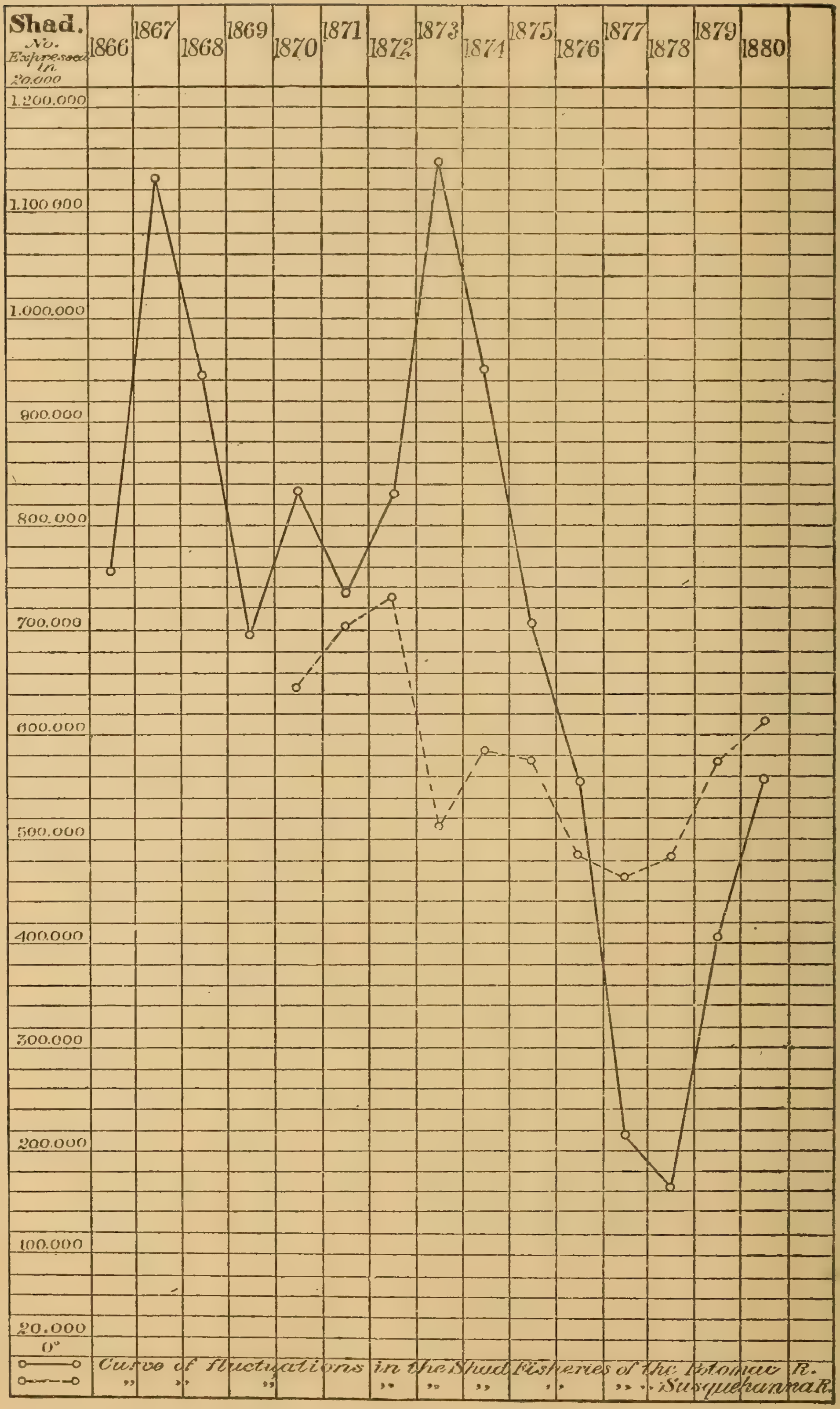
Statement showing amount of fish sold in Washington and Alexandria from 1865 *to* 1880 *inclusive.*

YEAR.	NO. SHAD.		
	Alexandria.	Washington.	Total.
1866.	224,096	530,200	754,296
1867.	777,775	350,420	1,128,195
1868.	714,625	230,151	944,776
1869.	417,878	277,125	695,003
1870.	301,137	527,140	828,277
1871.	333,516	401,132	734,648
1872.	367,322	464,136	831,458
1873.	289,729	852,900	1,142,629
1874.	325,340	628,637	953,977
1875.	243,643	464,215	707,858
1876.	237,096	319,079	556,175
1877.	85,562	131,199	216,761
1878.	45,138	121,785	166,923
1879.	77,809	327,537	405,346
1880.	134,081	421,041	555,122
Total—15 years			10,621,444
Average per year for 15 years			708,096
" 66-70—5 yrs.			870,109
" 71-75—5 yrs.			874,114
" 76-80—5 yrs.			380,065

For convenience of reference these statements have been developed in the accompanying diagram. Unfortunately, no reliable records of the fisheries at the head of the Bay and the mouth of the Susquehanna River for the years prior to 1870, could be procured: and, consequently, no such comparative diagram, or statement, of the movement of the fish previous to that time can now be made. Before analyzing the diagram let us glance at the table showing the amount of fish *marketed* in Washington and Alexandria during the last fifteen years;—the records of sales in these two cities indicating, pretty accurately, the yield from the Potomac River, perhaps ten or twenty per cent. of the total amount being taken up by the inhabitants of the adjacent country.

Assuming, then, that the number of fish sold in the two cities named represents the yield of the Potomac, we have a total catch of 10,621,444 shad for the fifteen years from 1866 to 1880; giving an average of 870,109 for the first five years; 874,114 for the next five; and 380,065 for the period from 1876 to 1880; and showing a very remarkable decrease in the yield from this river. The yield for the second five years, that is, from 1871 to 1875, although apparently greater than the average of the previous five years, was, no doubt, the result of more extended fishing; as comparatively few fish were taken in 1866, in consequence of the fisheries not having recovered from the effects of the war, and of the fishermen being without equipment. It will be observed that this decrease would be even more marked but for the catches of 1879 and 1880; as, in the last mentioned year, when the results of artificial propagation began to be realized, we have 555,122—an increase of more than 200,000 over the average yield.

The average of the preceding five years, again, was enlarged by the exceptional yield of 1873; but the large catch of this year was probably owing to the prevalence of easterly winds and other meteorological influences; as


Shad.
No. Expressed in 20.000
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1.200.000
1.100.000
1.000.000
900.000
800.000
700.000
600.000
500.000
400.000
300.000
200.000
100.000
20.000
0°
Curve of fluctuations in the Shad Fisheries of the Potomac R.
" " " " " " " " " Susquehanna R.

we find, by turning to the table of the yield on the Susquehanna, that the *minimum* catch for that river occurred the same year. The increase in the Susquehanna for 1880, however, was as marked as that in the Potomac; thereby clearly indicating such increase as being the result of the deposit of the artificially produced fish in both these streams.

The diagram will further show that 1870—the first year in which it is possible to compare the yield of the two localities—was comparatively a *good* year for the Potomac fisheries and a *bad* one for those of the Susquehanna. The next year (1871) showed a decrease in the Potomac, with a corresponding increase in the Susquehanna. The following year—1872—the catch in the Susquehanna increased only 8,000 and that of the Potomac 96,810.

We next find the year 1873 to have been one of great abundance in the Potomac, and of great scarcity in the Susquehanna. In 1874 the Potomac decreased from 1,142,629 to 953,977; while the Susquehanna increased from 516,000 to 583,000.

We recognize in these statements the inevitable result of successive years of over-fishing; of disturbing the fish on their spawning beds; and of preventing them, altogether, from reaching such beds. The diagram indicates a continued, though somewhat irregular, downward tendency in the yield of the Potomac from 1873 to 1878; and of the Susquehanna from 1872 to 1877, the loss in both rivers being finally arrested by the same means.

It will be remembered that the work of shad hatching was commenced in 1875, and was continued the following year—principally at the head of the Bay. In 1876 and 1877 large numbers of young fish were released; and in 1878 a slight increase of shad was observed in the waters of the Bay—a remarkable feature of this increase being the preponderance of small male fish. In 1876 our operations at the head of the Bay were not prosecuted on a sufficient scale to enable us to transfer many of the young fish to the Potomac: but the numbers deposited in that river were increased from year to year, until, as will be seen by reference to the table of distribution to be found on page 43, 14,350,000 were deposited during last season.

As the Susquehanna region had the advantage of at least a year in the work of artificial propagation, we find that the ascent of the curve appears first upon the chart for that river. In 1878 the yield of the Potomac had reached its lowest figure, 166,923. From this point we have a marked increase in the yield of both rivers, whereas, prior to our efforts to repopulate these streams, there was almost always a decrease in the one whenever any decided increase was observed in the yield of the other.

The increase of the year 1880 was even more marked when we take into consideration certain meteorological influences and their effects upon other localities. It happened that during the early run of the shad in Chesapeake Bay southeasterly gales prevailed which must have driven the fish into Mobjack Bay in large numbers while seeking their native waters of the Potomac and the Susquehanna, since a much larger number were taken at the mouth of the York River and in Mobjack Bay during last season than had been captured the previous year—the catch being increased from 179,374 in 1879, to 239,804 in 1880.

INVESTIGATIONS.

The events of the year 1880 have not only demonstrated beyond question the truth of the theories which have been advanced, and on which the work of the Maryland Commission has been been based: but they have also opened up a new field for the usefulness of this Department: and it is now quite certain that the work of artificial propagation can be extended to those fishes whose habits have hitherto been little known.

The investigations of the last season indicate that the fishes inhabiting the salt water *exclusively* can be as readily propagated, artificially, and increased to as unlimited an extent as the *anadromous* fishes with whose spawning habits we had been more thoroughly acquainted. The necessity which compelled those fishes—the shad, herring, salmon, etc., which spend most of their lives in the salt water—to enter the rivers for the purpose of spawning enabled us the more readily to study their breeding habits at the time of such annual migration. These varieties, therefore, became the objects of especial care and attention in the infancy of the Commission's existence.

Experiments conducted during last season have demonstrated our ability to hatch and distribute several varieties of fishes, which inhabit our salt water solely, to the same extent as has been accomplished in the case of the shad, and, indeed, it is quite possible that the Bay mackerel may be propagated on a yet larger scale than has been attempted with the shad itself.

About the first of July of last year I received from Messrs. Marshall McDonald and R. E. Earll, who were employed upon that portion of the work of the 10th Census which relates to the fisheries of our coast, an intimation that the Bay mackerel were spawning in Mobjack Bay, and that ripe fish, whose eggs could be readily impregnated by artificial means, were to be had in some numbers from the pound nets operated in that locality. I proceeded to Mobjack Bay, accordingly, in the steamer "Lookout," and succeeded in obtaining a sufficient number of ripe fish of this variety, and also of the porgy, and some other sea-fishes of less importance, to enable me to determine what were the best forms of apparatus to be used in their manipulation. As the immediate object of my investigations was to determine the proper manner in which work should be conducted in the future, rather than to attempt the work itself at that time. our operations were restricted almost exclusively within experimental limits.

Prof. Baird, U. S. Commissioner of Fish and Fisheries, having kindly sent with me Prof. John A. Ryder, a young naturalist of thorough training and expert in microscopic work, we were able to study the embryology of the mackerel and porgy in a very thorough and satisfactory manner. The result of Prof. Ryder's investigations will be found in a paper prepared by him upon this subject, and which will be published in Prof. Baird's report to Congress.

As the eggs of the mackerel, unlike those of the shad, are somewhat lighter than water and manifest a consequent tendency to float upon the surface, the apparatus used in the cultivation of shad cannot be efficiently employed in their manipulation. It is, therefore, necessary that some other form of apparatus should be devised, as that used in the shad-hatching operations is so constructed that a current of water flows in at the bottom, buoying up the eggs, keeping them constantly in motion, and momentarily bringing fresh particles of water in contact with each egg.

Such a current, either in the conical vessels or in the cylindrical plunge buckets—both of which forms of apparatus have been described in previous reports—acts *against* the gravity of the eggs of the shad; but in the case of those of the mackerel, and of all others that have a tendency to float, the current acts *with* such tendency and causes the eggs to pile in masses at the surface of the water. Several forms of apparatus, in which the direction of the current is reversed, have been experimented with, and are found to act most satisfactorily.

It is hoped that during the next season the work can be conducted at the proper places and on a sufficiently large scale to enable us to determine which form of the vessels that have already been experimented with can be operated with the best results and with the greatest economy. Ripe mackerel can be found in considerable numbers in the lower part of the Chesapeake Bay, and it may be necessary, in order to conduct the work on a sufficiently large scale, to collect and hatch the eggs outside of the limits of the State, but the young fish can thereafter be very readily transported to the upper portions of the Bay.

The investigations of the past season have developed the fact that a considerable number of ripe mackerel may be secured in the neighborhood of Crisfield, and several fishermen, who have been employed in the capture of this fish, testify that it has not been a great many years since they could be found as far up the Bay as Baltimore, the mouth of the Patapsco River, and elsewhere.

It is certain that the number of this most valuable fish has been very materially diminished in the waters of the State, and that they are becoming more scarce every year. It will, doubtless, require several years to restore them to their former abundance, and to make the catch plentiful enough to furnish a sufficient number of spawning fishes to warrant the establishment of hatching-stations high up the Chesapeake Bay. But as the fish can be very readily transported, the proper mode of proceeding would seem to be to hatch them at favorable places, where they can be had in large numbers, and transfer the young from thence. It is quite likely that they will return periodically to the localities where they were first deposited, for this habit seems to be as strangely characteristic of the coast fishes as of those which inhabit or frequent more inland waters. By way of evidence in support of this expectation, I would refer to the experience of the U. S. Fish Commission in the propagation of cod, in Gloucester Harbor. During the winter of 1878 Prof. Baird established a small experimental station at this point and succeeded in hatching out some millions of young cod. These were liberated in the harbor at Gloucester, and the following summer and fall young cod, an inch or two in length, were frequently seen in the harbor, none of the fishermen or inhabitants of the town having ever before noticed the young of this fish in those waters. Young fish a year old, and measuring six or seven inches in length, were also taken the next season, and in considerable abundance, in the same neighborhood.

FISH-WAYS.

Having demonstrated the efficiency of the means employed to increase the yield of shad and other migratory fishes, it has now become essential to the thorough success of the work and for the distribution of its benefits to all parts of the State that means be provided for the ascent of these fish to localities from which they are now debarred by natural and artificial obstructions. Although there are no such obstructions in the Susquehanna within the limits of this State, yet the work of restocking the river proper, and of increasing the supply of fish at its mouth would be very materially assisted by opening the river to its sources, as this would not only enlarge the spawning grounds to a proportionate and very considerable extent, but would, at the same time, afford more and better opportunities for the capture of ripe fish.

The construction of proper fishways in the river, in Pennsylvania, and the discontinuance of the use of fish-weirs along the entire length of the river would very quickly yield the best results to the citizens of both States.

The interruption to the progress of fish in most of the rivers of the eastern portion of Maryland consists mainly in the means which are employed for their capture. This matter, however, is within the control of the inhabitants of those sections, to whom I would earnestly recommend the discontinuance of the use of such methods.

Among the principal streams of the Western Shore we have the Gunpowder River, which is obstructed by a dam of recent construction, a part of the system for supplying the city of Baltimore with water. This and other minor obstructions should be provided with fishways, and if the shad, herring and rock were thus allowed free access to the upper waters of the river, the fisheries below the dam and at the mouth of this stream would soon be vastly improved.

The Patapsco River is also obstructed by many dams, none of which have been provided with effective fishways, although they are especially required by law.

In order to illustrate the practicability of restoring the shad, herring and rock to waters in which they were formerly abundant, but where they have since become unknown, I requested Col. Marshall McDonald, the Commissioner of Fisheries of the State of Virginia, who had made the construction of fishways a specialty, to examine the Patuxent River and advise me as to what could be done on this stream.

If the shad could be brought back in numbers to Laurel, after having disappeared from the river for years, the citizens of Maryland would be satisfied as to the good that would be accomplished by the erection of fishways over all of the artificial obstructions in the State.

That many miles of the Patuxent River, at least, can be opened to the migration of these valuable fishes, will be seen by the following report made as the result of the examinations of that river:

Obstructions to the Ascent of Fish on the Patuxent.

MAJOR T. B. FERGUSON,
Commissioner of Fisheries for Maryland.

DEAR SIR:—Maj. O. C. Henderson, whom I sent to ascertain the number and character of the obstructions to the ascent of fish on the Patuxent, reports as follows:

The first dam is at Jericho Mills, about three hundred yards below R. R. Bridge (B. & P. Railroad), about one and one-half miles from Bowie.

The dam is built of brush and stone, and the difference of water level, above and below the dam, is 3 feet.

At low stages of water none passes over the dam. Ordinarily, in April, May and June surplus water passes over the dam in sufficient quantity to feed a fishway without interfering with mill supply.

At the present time no shad or rock ascend to this point, and rarely a herring. This is due to the complete obstruction of the river by nets and weirs below.

The 2nd obstruction reported by Major Henderson, is the dam of the Iron Works Mills, four miles below Laurel and one and one-half miles from Contee station, Washington branch B. & O. R. R. The difference of water level at this dam is only about 2 feet.

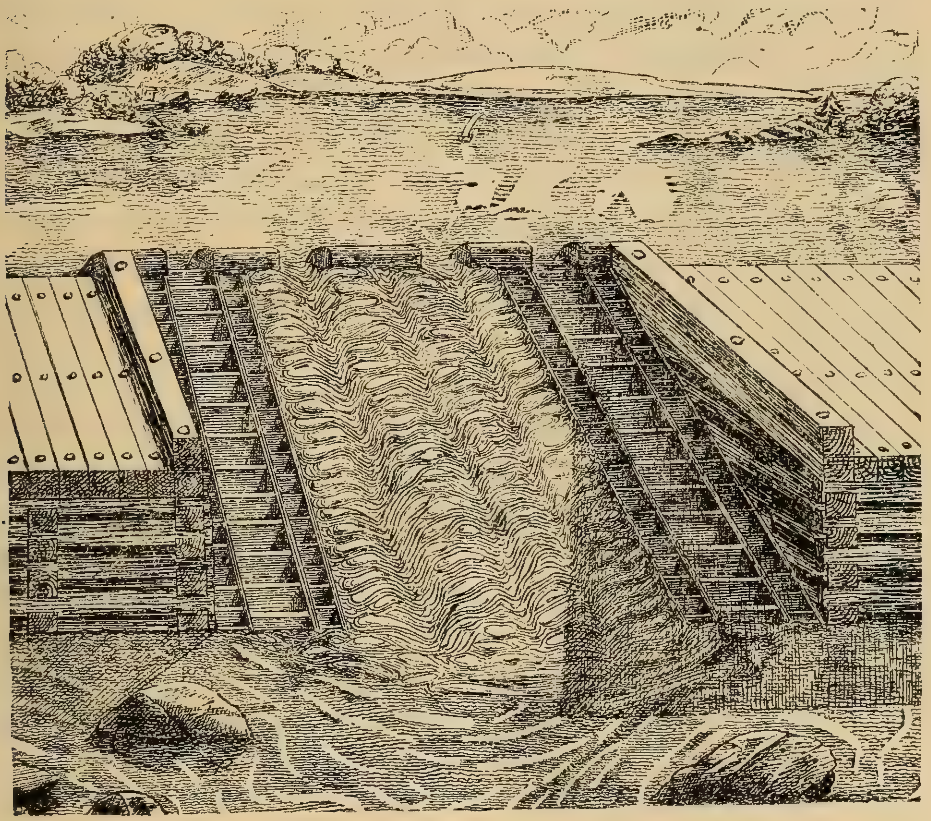
At Avondale Mills, about one and one-half miles below Laurel, is a stone dam about five feet high, which is the third and last obstruction on the river until you ascend to the dam of the Laurel Cotton Mills.

The dam of the Laurel Mills is built of stone, and is about 28 feet high. At ordinary summer stages of water, there is no discharge of water over the dam. The whole stream is diverted to furnish motive power to the cotton mills, and at very low stages of water this is supplemented by steam power.

The river may be opened to the Laurel Mills so as to permit free passage of fish with comparatively little trouble and at a very moderate expense.

Below this point the supply of water is considerably in excess of the amount used for motive power, and a sufficient quantity of water may be discharged through the fishways to invite the ascent of shad, which are a timorous fish, and indisposed to enter a way discharging an inconsiderable volume of water.

The general plan of fishway I would recommend for the three lower dams of the Patuxent is represented in the accompanying cut, which represents a fishway discharging a volume of water from 12 to 15 inches deep and ten feet wide.



McDONALD FISHWAY,

Showing working at low water stage.

For economy of water supply at low stages of water, the middle section five feet in width is depressed below the plane of the sides, so that only this middle section takes water when the river is low. In full stages of water the whole breadth of the fishway discharges.

Fishways should always, when practicable, be recessed into the dam, so that the discharge from the lower end of the fishway will be on a line with the lower face of the dam. Where not practicable to recess the fishway as indicated, then it should be placed next to the bank and a sloping apron placed in the angle between the fishway and the dam, so as to establish an uninterrupted line of overfall from the mouth of the fishway to the dam. This construction will in the case of low dams practically place the mouth of the fishway in the line of the face of the dam.

In the case of high dams it will probably be better to build the fishway with a return or elbow, so as to make the discharge at the face of the dam.

In the case of the Laurel Mills dam, there being no surplus of water to deal with ordinarily, the fishway may be made much narrower and the water discharge proportionally reduced ; a width of two or four feet for the water way would in this case be enough. Such a fishway would provide access to the upper waters of the Patuxent for the salmon, the herrings and all the anadromous or river species, except the shad. I doubt if the volume of water would be sufficient to induce the ascent of the last named species in considerable numbers.

I also examined the dam at the Relay House, on the Patapsco. This is a timber dam about 7 feet high, and is the first obstruction on the river above tide-water. Upon the dam there is now a crude fishway of the old style, built by the owner, I presume, in conformity to the requirements of the State law.

It is not probable that the State will enter upon the enforcement of a law making the erection of fishways obligatory, until their efficiency has been tested and approved by your State Commission.

The dam above mentioned furnishes an admirable location for making the experimental tests required.

I have therefore carefully examined the locality, and submit to you the general plan of a fishway, such as I think well adapted to meet the particular requirements of the case, and if approved, will serve as a model for subsequent constructions.

The cost of this construction will be from five to eight hundred dollars, varying with the cost of securing the foundations on which to build the superstructure.

Very respectfully yours,

M. McDONALD.

XVII

SHAD—*Alosa sapidissima.*

The co-operation of the U. S. Fish Commission, during previous years, having proved so important in general results and so advantageous to the State of Maryland, I naturally sought a continuance of such co-operation and assistance in arranging for our spring work.

I was most fortunate in securing the detail of two machinery Barges, together with two others, which had been furnished with quarters for the employes, for the station at the Head of the Bay, to which they were transferred in the latter part of April.

Prof. Baird had obtained from the Secretary of the Navy the loan of two steam launches which could be readily used in collecting the eggs of the Shad, both from the large fisheries and from the gillers operating in the neighborhood of Havre de Grace, I, therefore, determined to utilize the Steamer "Lookout" on the Potomac River. As she was provided with hatching apparatus sufficient to accommodate from 600,000 to 1,000,000 eggs, we confidently expected to hatch out several million eggs during the fishing season on this river.

POTOMAC RIVER.

During an inspection of the fisheries on the Potomac River, on the 26th of April, I chanced to arrive at Mr. Skidmore's fishery, at Moxley's Point, about 6 o'clock in the afternoon, as the seine was being landed, and found unexpectedly, a considerable number of ripe male and female shad.

About a quarter of a million of eggs in good condition were readily secured, but as it was considerably earlier in the season than we had ever before obtained ripe shad on this river, the hatching appartus had not yet been placed in running order, and, after keeping the eggs a few hours in pails, I emptied them into the Eastern Branch of the river at a point near the Navy Yard.

Finding the season so unusually advanced I immediately secured the equipment of the Steamer for the spring work and commenced active operations on the 4th day of May. About 650,000 eggs were secured at Moxley's Point on the same night, and as this number completely filled the apparatus on the Steamer, the work of taking eggs was necessarily discontinued until additional apparatus could be improvised for their reception.

This success on the Potomac, it should be remembered, was wholly without precedent and as we had provided means only for hatching eggs in such numbers as we had hitherto been able to secure, we were totally unprepared to handle the quantities which were obtainable at this period.

In this state of affairs I again looked to Prof. Baird for assistance, and through his influence secured from the Navy Department permission to use the hydrant water in the Navy Yard at Washington, and also to put up aparatus for developing the eggs which might be gathered by the "Lookout."

The assistance which was obtained from the Machine Shops at the yard enabled us, in a few days, to have a dozen cones running, which was as many as I thought it necessary to provide, for with these we were prepared to take care of from twelve to eighteen hundred thousand eggs, and I did not hope to have more than this number on hand at one time. It must be borne in mind that it only required about three days from the time that the eggs were taken for their full development, when they could either be deposited in local waters or transferred to other points, leaving the vessels free to receive fresh supplies. As the "Lookout," however, gathered from one to two million eggs a night during this period, the apparatus which was erected was taxed to its utmost capacity, and additional cones were added as fast as they could be manufactured until, finally, their number reached forty six exclusive of the half dozen on the bow of the "Lookout," which were used as receptacles for the eggs as they were gathered, and for their transfer from the points below Alexandria to the Navy Yard. All of these vessels were simultaneously employed upon several occasions during this short season—some times turning out as many as 2,000,000 young fish in a day.

The details of these operations may be found in the accompanying tables from which it will be seen that nearly 19,000,000 fish were produced at this somewhat impromptu establishment. Of this number over 14,000,000 were deposited in the waters of Maryland. The record of this distribution will be found on page 43, combined with that of the fish produced at Havre de Grace.

If this extraordinary success could have been anticipated, and sufficient apparatus in working order had been provided from the commencement of the season, I am quite confident that the total result above given would have been increased to over 30,000,000. But when the records of the hatching operations on the Potomac River for 1880 are compared with those of other years, as given in previous reports, it will be seen that the organization of the work on such a scale would have appeared wholly unnecessary.

The Steamer "Lookout" continued her nightly trips down the river with varying success until the end of June.

As the law prohibiting the catching of fish after the 1st of June is utterly ignored on the Potomac, outside of the District of Columbia, I determined to gather all the spawn that could be obtained from the fish taken, and from them producing as many young fish as possible in order to keep up the future supply in this river. The experiences of this year on the Potomac are most important, not only on account of the magnitude of the work and of the results accomplished, but as affording a clear indication of the good results of our former efforts and as demonstrating how readily and successfully the work can be conducted in the future, so long as we can secure the valuable co-operation of the U. S. Government.

It is quite possible that the period of the runs of Shad in the rivers has a close relation to the time in which the young fish are originally hatched, and the early run may possibly be the result of the fish which are first hatched in any given season.

The disturbance of the fish for many years by seines and gill-nets has interfered materially with the production of young from the earliest spawners, and from this cause the early runs were gradually becoming exhausted. It is possible that as by artificial propagation we have been able to deposit young fish, produced from spawn taken from the early runs, the earlier schools have been increased, and we are not now dependent solely for the supply of the future upon the limited number of fish produced by the late runs, which spawn after the season is so far advanced that most of the seines and gill-nets have ceased their operations.

U. S. AND MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF TEMPERATURE OBSERVATIONS made at Washington, on the Steamer Lookout, from May 4th, 1880, to June 18th, 1880, by W. P. Sauerhoff and Wm. Hamlen.

DATE.		TEMPERATURE OF—										WIND.						CONDITION OF—				STATE OF—			
Day of Week.	Day of Month.	Air.	Surface Water.	Bottom.	Air.	Surface Water.	Bottom.	Air.	Surface Water.	Bottom.	Depth of Water at Station.	Direction.	Intensity.	Direction.	Intensity.	Direction.	Intensity.	Sky.	Sky.	Sky.	Water.	Tide.	Tide.	Tide.	
		6 a.m.			12 m.			6 p. m.				6 a. m.		12 m.		6 p. m.		6 a. m.	12 m.	6 p. m.		6 a. m.	12 m.	6 p. m.	
Tuesday	4							76	68	67	20 feet.	S. E.	Light	S. E.	Light	S. E.	Light	Clear	Clear	Clear	Muddy		Flood	Ebb	*a*
Wednesday	5	67	67	66	82	72	70	78	69	68	"	E.	"	E.	"	E.	"	"	"	"	"	Flood	Slack	"	
Thursday	6	68	67	66	84	73	66	81	71	70	"	W.	"	W.	"	N. W.	"	"	"	"	"	"	Ebb	Flood	*b*
Friday	7	65	67	66	80	71	70	78	72	70	"	S. W.	"	E.	"	S. E.	"	Cloudy	"	"	"	"	"	"	
Saturday	8	61	68	66	85	73	71	81	72	70	"	N. E.	"	N.	"	N. E.	"	"	"	Cloudy	"	"	"	"	*c*
Sunday	9	72	70	67	90	74	72	85	76	75	"	S.	"	S.	Fresh	S.	"	Clear	"	Clear	"	"	Flood	Ebb	*d*
Monday	10	72	71	70	91	76	75	83	75	74	"	S.	"	S.	"	S.	Strong	"	"	"	"	"	Ebb	Flood	*e*
Tuesday	11	71	73	72	82	76	75	61	74	73	"	S. E.	"	N.	Light	N. W.	"	"	"	Cloudy	"	"	"	"	*f*
Wednesday	12	62	71	70	75	74	73	71	73	72	"	W.	"	N. W.	"	N. W.	Fresh	"	"	Clear	"	"	"	"	*g*
Thursday	13	61	70	70	73	73	73	60	72	72	"	W.	"	N.	Fresh	N. E.	"	"	"	Cloudy	"	"	"	"	*h*
Friday	14	57	70	70	67	70	70	65	69	69	"	N. W.	Fresh	N. W.	"	N.	Light	"	"	Clear	"	"	"	Slack	*i*
Saturday	15	52	65	65	70	71	71	67	71	71	"	N. E.	Light	N. W.	"	N. W.	"	"	"	"	"	"	"	Ebb	*j*
Sunday	16	68	67	67	84	72	71	81	72	71	"	S. W.	"	S. W.	Light	S. W.	"	"	"	"	Clear	Ebb	Flood	"	*k*
Monday	17	71	70	70	90	72	71	83	73	72	"	W.	"	W.	"	W.	"	"	"	"	"	"	"	"	*l*
Tuesday	18	69	70	70	86	74	73	83	75	74	"	N. W.	"	N. W.	"	S. W.	"	"	"	"	Muddy	"	"	"	*m*
Wednesday	19	66	73	72	88	75	74	81	76	75	"	N. E.	"	N. E.	"	N. E.	"	Cloudy	"	"	"	"	"	"	*n*
Thursday	20	78	75	74	87	76	75	87	76	75	"	S. W.	"	S. W.	Fresh	S. W.	Fresh	Clear	"	"	"	"	"	"	*o*
Friday	21	71	74	74	88	77	76	86	76	75	"	S.	"	S. W	Strong	S. E.	Strong	"	Cloudy	"	"	"	"	"	*p*
Saturday	22	71	74	75	73	75	75	70	75	75	"	S. E.	"	S. E.	Light	N. W.	Light	Cloudy	"	Cloudy	"	Flood	Ebb	"	*q*
Sunday	23	70	74	75	68	74	75	67	74	75	"	N. E.	"	N. E.	"	N. E.	"	"	"	"	"	"	"	Flood	*r*
Monday	24	71	75	75	88	75	75	85	75	75	"	N. E.	Calm	S.	"	S. W.	"	"	Clear	Clear	"	"	"	"	*s*
Tuesday	25	80	76	76	85	76	76	88	77	76	"	S.	Light	S.	"	S.	"	Clear	"	"	"	"	"	"	*t*
Wednesday	26	75	77	77	87	79	78	89	77	66	"	S.	"	S. W.	"	S.	"	"	Cloudy	Cloudy	"	"	"	"	*u*
Thursday	27	72	79	78	89	82	81	89	79	78	"	S.	"	S. W.	"	S. W.	"	"	"	Clear	"	"	"	"	*v*
Friday	28	75	78	78	85	80	80	78	79	78	"	S.	"	S. W.	Fresh	W.	Strong	"	"	Cloudy	Clear	"	"	"	*w*
Saturday	29	75	79	78	75	80	80	74	78	78	"	N. E.	"	N. E.	Light	N. E.	Light	"	Clear	"	Muddy	Ebb	Flood	Ebb	*x*
Sunday	30	73	78	78	74	77	77	73	77	78	"	S. E.	"	N. E.	Fresh	S. E.	Fresh	Cloudy	Cloudy	"	"	"	"	"	*y*
Monday	31	72	77	77	78	77	77	83	78	78	"	N. W.	Fresh	N. W.	"	N. W.	Light	Clear	Clear	Clear	Clear	"	"	"	*z*
Tuesday	1	75	77	77	94	78	78	85	78	78	"	S. W.	Light	S. W.	Light	S. W.	"	"	"	Cloudy	Muddy	"	"	"	*a*
Wednesday	2	60	73	73	68	73	73	62	73	73	"	N. W.	Fresh	N. W.	Fresh	N. W.	"	Cloudy	Cloudy	"	"	"	"	"	*b*
Thursday	3	60	75	74	78	77	77	80	77	77	"	N. W.	Light	N. W.	Light	S.	"	Clear	Clear	Clear	"	"	"	"	
Friday	4	62	75	74	87	76	76	84	77	77	"	N. W.	"	S. W.	"	S. W.	"	"	"	"	"	"	"	"	
Saturday	5	70	74	75	79	76	75	80	77	76	"	S. W.	"	S.	"	S.	Fresh	Cloudy	"	Cloudy	Clear	"	"	"	
Sunday	6	69	75	74	78	76	75	77	76	75	"	S.	"	S.	Fresh	S.	Light	Clear	"	"	"	Slack	Ebb	Flood	
Monday	7	76	74	74	88	79	78	83	76	75	"	S.	"	W.	Light		Calm	"	"	Clear	"	Flood	"	"	
Tuesday	8	73	74	74	83	79	76	86	79	77	"	N. W.	"	N. W.	"	N. W.	Light	"	"	Cloudy	"	"	"	"	
Wednesday	9	70	75	74	78	75	75	76	75	75	"	N. E.	"	N. E.	"	N. E.	"	Clondy	Cloudy	"	"	"	"	"	
Thursday	10	68	75	75	72	75	75	74	75	75	"	S. E.	"	S. E.	"	S. E.	"	"	"	"	"	"	"	"	*c*
Friday	11	74	74	74	88	77	77	87	79	78	"		Calm	S.	"	S.	"	"	Clear	"	"	"	"	"	
Saturday	12	76	77	77	94	79	78	79	79	78	"	S.	Light	N. W.	"	S. E.	"	Clear	Cloudy	"	"	"	"	"	*d*
Sunday	13	80	78	77	95	79	78	90	82	81	"	N. W.	"	N. W.	Fresh	W.	"	"	Clear	"	Muddy	"	"	"	
Monday	14	77	78	78	85	79	78	83	78	78	"	N. W.	"	N.	Light	N. E.	"	"	"	"	"	Ebb	Flood	Ebb	*e*
Tuesday	15	67	78	78	66	77	77	65	76	77	"	N. E.	"	N. E.	Fresh	N. E.	"	Cloudy	Cloudy	"	"	"	"	"	*f*
Wednesday	16	65	76	76	74	77	77	75	77	77	"	N. E.	"	N. E.	Light		Calm	"	"	"	"	"	"	"	*g*
Thursday	17	70	75	76	85	77	77	84	78	78	"	N. W.	"	N. W.	"	N. W.	Light	Clear	"	Clear	"	"	"	"	*h*
Friday	18	68	75	75	86	77	77	85	79	78	"	S.	"	S.	"	S.	"	"	Clear	"	"	"	"	"	*i*

a. Left Navy Yard 12.45 p. m. Returned at 9.50 p. m. 650,000 eggs.
b. Thermometer 98° at 2.30 p. m.
c. Left Navy Yard 5.40 p. m.
d. Returned to Navy Yard 1.20 p. m.
e. Left Navy Yard 4.15 p. m. Returned 11.10 p. m.
f. Left Navy Yard 12.50 p. m. Rain 5.30 p. m. Stopped 7 p. m.
g. Returned to Navy Yard 8.53 a. m. Left Navy Yard 3 p. m.
h. Returned Navy Yard 9.25 a. m.
Left " " 4 p. m.
i. Returned to Navy Yard 11.35 a. m.
j. Left Navy Yard 1.35 p. m.
Returned 10.30 p. m.
k. Remained at Navy Yard.
Left Navy Yard 1.22 p. m.
l. Returned 12.30 p. m.
m. Left Navy Yard 5.40 p. m.
Returned 11.15 p. m.
n. Remained at the Navy Yard.
o. Left Navy Yard 3.27 p. m.
p. Returned to Navy Yard 9.05 a. m.
Left Navy Yard 4.10 p. m.
q. Returned to Navy Yard 7.20 a. m.
Left Navy Yard 5.30 p. m.
r. Returned Navy Yard 9.10 a. m.
Left 5.55 p. m.
s. Returned Navy Yard 8.05 a. m.
Left Navy Yard 6.15 p. m.
t. Returned Navy Yard 6.25 a. m.
Left " " 6.30 p. m.
u. Returned Navy Yard 6.45 a. m.
Left " " 8.17 p. m;
v. Returned to Navy Yard 7 a. m.
Left " " 12.50 p. m.
w. Returned to Navy Yard 7.15 a. m.
Left " " 3 p. m.
Returned " " 9.05 p. m. Rain.
x. Left Navy Yard 3.20 p. m.
Returned Navy Yard 9.40 p. m. Rain.
y. Left Navy Yard 4 p. m.
Ret. " " 10.10 p. m.
z. Left Navy Yard 6.30 p. m.
Ret. " " 12.25 p. m.
a. Left Navy Yard 5 p. m.
b. Stationed at Ft. Washington.
c. Rain 6.30. Stopped 11 a. m.
d. Rain storm 3 p. m. Stopped 4.30 a. m.
e. Rain 9.30 p. m.
f. Rain.
g. Rain stopped 7.30 a. m.
h. Strong current with the ebb tide. Water very muddy at 7 p. m.
i. Water very muddy.

MD. COMMISSION FISH AND FISHERIES.

RECORD OF SHAD HATCHING OPERATIONS conducted at Washington, D. C., on the Str. Lookout and wharf at Navy Yard, from Tuesday, May 4th, 1880, to Sunday, June 27th, 1880, by Messrs. Sauerhoff, Hamlen and Clark.

Date.		Sources Whence Fish were Obt'ed.		Fish Taken by—					Ripe Fish					
				Haul-seines.				Gill-nets						
Day Week.	Day of Month.	Total length of haul-seines visited. Fathoms	Total length of gill-nets visited. Fathoms.	No. Shad.	No. Herring	Lbs. of Rock.	Other Fish.	No. Shad	Males.	Females.	Eggs Obtained.	Fish Hatched.	Fish Deposited in Local Waters.	Fish Deposited in Other Waters.
Tuesday	May 4	300		400	700		400		39	35	650,000			*a.*
Wednesday	5													*b.*
Thursday	6													*c.*
Friday	7													*d.*
Saturday	8	300			75,000		500					635,000	635,000	
Sunday	9	300		103	30,000		300		17	16	320,000	310,000	50,000	*e.*
Monday	10													*f.*
Tuesday	11			227	20,000	15	1,000	320	23	19	380,000	360,000	310,000	*g.*
Wednesday	12				17,000	25	450	430	27	25	500,000	470,000		*h.*
Thursday	13	200		166	23,000	18	200	179	67	50	1,000,000	850,000		
Friday	14													*i.*
Saturday	15			376	3,000	30	75	135	47	38		725,000	360,000	*j.*
Sunday	16										760,000		320,000	

a. Eggs obtained at Moxley's Pt., Capt. Skidmore.
b. Remained at Navy Yard. Cones overcrowded.
c. Remained at Navy Yard.
d. Fish hatching out.
e. Obtained 1,220,000 herring eggs at Moxley's Point; Lost 120,000 herring eggs at Moxley's Point.
f. Seines not hauling on account of tide.
g. 320 eggs from gill-nets; 60,000 eggs from haul-seines; 300,000 herring deposited in the Potomac.
h. Obtained 180,000 herring eggs at stake net.
i. Remained at Navy Yard.
j. 180,000 herring deposited at Cumberland, Md.

MD. COMMISSION FISH AND FISHERIES.

RECORD OF SHAD HATCHING OPERATIONS conducted at Washington, D. C., on the Str. Lookout and wharf at Navy Yard, from Tuesday, May 4th, 1880, to Sunday, June 27th, 1880, by Messrs. Sauerhoff, Hamlen and Clark.—Cont'd.

Date.		Sources Whence Fish were Obt'ed.		Fish Taken By—					Ripe Fish					
				haul-seines.				gill-nets						
Day Week.	Day of Month.	Total length of haul-seines visited. Fathoms.	Total length of gill-nets visited. Fathoms.	No. Shad.	No. Herring	Lbs. of Rock.	Other Fish.	No. Shad	Males.	Females.	Eggs Obtained.	Fish Hatched.	Fish Deposited in Local Waters.	Fish Deposited in Other Waters
Monday	May 17	537			1,500	17	125	425	115	104	2,070,000	2,036,000	400,000	
Tuesday	18			979	400	25	150	150	63	57	1,114,000	1,084,000	200,000	
Wednesday	19													1600000*a*
Thursday	20				100	37	200	73	87	76	1,520,000	1,300,000	400,000	
Friday	21	300		735	250	75	200	325	130	119	2,320,000	2,000,000	800,000	
Saturday	22	300		650	400	25	150	197	70	55	1,100,000	1,000,000	825,000	
Sunday	23	300		475	250	20	400	250	29	26	520,000	450,000		2000000
Monday	24	300		560	100	15	600		25	20	400,000	350,000	800,000	
Tuesday	25	300		327	150	8	700	297	19	15	300,000	250,000	1,400,000	
Wednesday	26	300		36	25	30	400	97	2	2	30,000		2,400,000	*b*
Thursday	27	300		187	125	60	125	129	2	2	40,000		450,000	
Friday	28	300		199	200	40	50	179	15	14	280,000	230,000	150,000	200000
Saturday	29		400					325	21	18	325,000	275,000	250,000	
Sunday	30		525					393	22	38	760,000	675,000		
Monday	31		575					257	39	53	1,040,000	900,000		
Tuesday	June 1		425					127	19	23	430,000	300,000	30,000	200000
Wednesday	2		380					251	46	50	840,000	700,000	275,000	
Thursday	3		575					249	23	23	410,000	375,000		
Friday	4		500					157	23	25	430,000	400,000	675,000	

a. Remained at Navy Yard. Cones overcrowded.

b. Eggs of the 26th and 27th were so poor that none were hatched.

Saturday	June	5		275					37	5	5	95,000	90,000	900,000		*a*
Sunday		6												300,000	700000	*b*
Monday		7		450					202	32	37	650,000	615,000	375,000		
Tuesday		8		775					254	37	39	670,000	600,000	400,000		
Wednesday		9		725					114	18	24	400,000	375,000	100,000		*c*
Thursday		10		500					157	5	6	100,000	85,000			
Friday		11													300000	*d*
Saturday		12												575,000	240000	*d*
Sunday		13												475,000		*e*
Monday		14		375					205	29	31	520,000	450,000	*85,000		
Tuesday		15		175					72	9	10	140,000	100,000			
Wednesday		16		250					276	20	24	315,000	300,000			
Thursday		17		275					108	11	10	180,000	160,000			
Friday		18												*50,000	400000	*f*
Saturday		19												*100,000		*g*
Monday		21										20,000	15,000			*h*
Tuesday		22										120,000	85,000	*160,000		
Sunday		27												*100,000		
			4037	7180	5420	172,200	440	6025	6370	1136	1089	20,749,000	18,550,000	14,350,000	4200000	

a. Eggs placed in hatching boxes at Ft. Washington.
b. No boats gilling.
c. 100,000 shad placed in the Potomac at Ft. Washington.
d. Str. remained at Navy Yard. Str. remained at Navy Yard.
d. " " " "
e. 175,000 shad used for experimental purposes.
* 85,000 " " " " "

f. Steamer remained at Navy Yard.
* 50,000 shad used for experimental purposes.
g. Steamer remained at Navy Yard.
* 100,000 shad used for experimental purposes.
h. Steamer remained at Navy Yard on 20th.
* 160,000 shad used for experimental purposes.
* 100,000 shad used for experimental purposes.

HAVRE DE GRACE STATION.

This station was placed under the immediate charge of Mr. John S. Saunders of Baltimore, who had obtained considerable experience in shad work during his employment by the U. S. Commission in North Carolina, in the seasons of 1878-9.

The barges, to which reference has hitherto been made, having been remodled and placed in thorough order during the time they were laid up at Baltimore, I directed that they should be transferred to Spesutie Narrows, a convenient and central locality, from which the large fisheries and the gillers could readily be reached. The entrance to this harbor had been dredged by the Engineer Department, to allow safe passage for the steam launches. During the early portion of the season, while the haul seines were being operated on Spesutie Island and on the Floating Batteries adjacent, these fisheries were visited daily and eggs obtained from them, as well as from the gill-nets which were drifted on the flats.

An extended drought, with a prevalence of south-easterly winds, caused the salt water to back up the bay, and the water became so brackish in Spesutie Narrows as to endanger the eggs. It was, therefore, found necessary on the 30th day of May to remove the barges from this locality to a point above Havre de Grace, between Watson's Island and the Cecil County shore. This change of location in the midst of the season no doubt contributed materially towards lessening the results obtained at this station.

Particulars of the work conducted under the supervision of Mr. Saunders will be found in his report and journal which are herewith submitted.

MARYLAND COMMISSION FISH AND FISHERIES,

BALTIMORE, Md., Sept. 25th, 1880.

MAJ. T. B. FERGUSON,

My Dear Sir :—Please find herewith enclosed a rough journal of operations at Havre de Grace during the months of May and June. In forwarding the same, I would make a few suggestions in regard to some changes which I think would be beneficial. There should be some cover or awning made to protect the cylinders in case of rain, as the drops kill the eggs and young fish, and we found it impossible to cover them with tops, the rain coming on us so rapidly. A folding awning could be easily arranged to drop in a few minutes.

There should also be a hinged plank placed on the sides of the barge to enable the men to walk around the outside of it in order to examine the cylinders, place eggs in them and remove young fish, as we found it extremely difficult to do so from boats. This arrangement could be made at slight cost, and would not be at all unsightly. I consider the working of the cylinders as now arranged a great success, and after a careful examination think the results are fully a third more, in hatching, than are obtained in cones; the economy of labor and attention being very much in favor of the cylinders. There should be some improvement made in fastening wire bottoms to cylinders, since as they are now made, they break at the outer band and lose a great many young fish. I would also advise a net being placed under them to prevent eels &c., from sucking the eggs through the bottoms. I would also suggest, for future service, that a better class of engineers be employed, as a great responsibility is placed upon them, and they should be both careful and competent to repair any breaks &c., in the machinery. Six or eight first-class, reliable men would do more, I think, in getting spawn &c., than a larger number; for it was my misfortune this season to be troubled with quite a number, when the same results, and perhaps better, could have been accomplished with half the number of reliable men.

Very respectfully yours,
JNO. S. SAUNDERS.

April 29.—Cast off from City yard, South Baltimore, with three (3) barges in tow of tug boat "Mohawk" at 10.15 A. M., cast off from tug "Mohawk" at 11 A. M.; off Fells Point, and was taken in tow by U. S. Revenue Cutter "Ewing" to be carried to Spesutie Narrows, head of Chesapeake Bay. Had heavy wind from S. E. with rain all day. Arrived off Narrows at 5.00 P. M. Dropped anchor at 5.20 P. M. at Narrows where we remained all night on account of heavy wind and rain. Steamer returned to Baltimore after seeing us safely anchored.

April 30.—Wind changed to N. W. about 1 A. M. with heavy rain. Wind increasing until about 4 A. M. when it was blowing a gale. Had to let go all anchors, as also anchor Machinery barge by itself and Steam launch. Wind blowing a gale all day.

May 1.—Wind calmed down about 4 A. M. when all hands were called. Weighed anchors and succeeded in getting barges safely moved in Narrows about 12 M. Left in Launch at 1 P. M. for Havre de Grace, where I telegraphed arrival &c., to Maj. Ferguson. Returned to Narrows about 4 A. M. Wind N. W.

May 2.—Clear and pleasant. Had men cleaning up and regulating cones. Gave the steam launch a coat of paint. Wind S. E.

May 3.—Clear and pleasant. Discharged colored cook on account of negligence and drunkeness. Placed Freedy in charge of kitchen. Sent men to gather spawn; they returned about 11 P.

M. bringing about 40,000 eggs. The eggs were very indifferent. Frank Farr reported for duty as pilot for Launch and brought colored boy to do temporary cooking. Wind S. W.

May 4.—Clear and warmer. Sent men out to the Batteries. They returned with about 275,000 eggs. Machinist Flynn and Fireman Slavin reported for duty. Wind gentle from S. W.

May 5.—Clear and pleasant. Reported result of taking eggs to Maj. Ferguson. Men went to Batteries, returned with about 150,000 eggs. Frank Courtney reported for duty. Wind during day N. E., E. and S. E. Received word that Maj. Ferguson would be down.

May 6.—Clear and pleasant. Sent Launch to Havre de Grace for Maj. Ferguson, leaving men at Batteries on way up. Maj. Ferguson arrived about 1 P. M. bringing Mr. Davenport and colored cook M. Robinson. Maj. Ferguson returned about 4. P. M. Launch returned about 9 P. M. bringing men from Batteries. They obtained 475,000. M. Gleason reported for duty and was assigned to care of cones and hatching. Wind variable N. to. W.

May 7.—Clear and pleasant. Sent Launch to Harve de Grace for mail, leaving men at Batteries on way up. They returned about 8 P. M. bringing about 400,000 eggs. Turned much colder after sundown with heavy wind from S. E. First eggs hatched. Eggs not doing well on account of being badly impregnated, as also stoppage of water by foul pipes. Mr. Davenport accompanying men at night.

May 8.—Cloudy and overcast. Cleared away about 11 A. M. Left for Baltimore at 9.52 and returned at 4 P. M. Accompanied men at night in getting eggs and returned at 11 P. M. with

550,000. Great scarcity of ripe male fish, causing bad impregnation of eggs. Had inventory of scow taken. Colored boy (acting as cook) left.

May 9.—Clear and warm. Sent men to Batteries, gillers not being able to cast on account of heavy wind. They returned with about 250,000 eggs. Wind S., S. W.

May 10.—Clear with wind strong from S. W. Eggs hatching out rapidly. No instructions as to distribution of fish. Received box containing the following articles: Small wrench, tallow pot, two ½ inch round files, piece of packing and boat hook. Men returned about 9. P. M. with about 250,000 eggs. Wind strong from S. W.

May 11.—Clear and pleasant. Received orders to turn out all young fish in river above Havre de Grace. Turned out at 5 P. M. above Havre de Grace 150,000 fish, and about 250,000 off Narrows, not having cans with which to transport them above Havre de Grace. Sent Mr. Davenport to Washington as ordered. Received bundle containing pillows. Visited Batteries. Large catch of shad (new run) but none ripe. Obtained about 180,000 eggs from gillers. Great quantities of perch taken in haul seines. Attempted to get eggs but was unsuccessful.

May 12.—Clear and pleasant. Wind strong during day from N. W. Sent 145,000 young fish above Havre de Grace, and also turned out 100,000 off Narrows. Launch returned bringing Mr. Davenport and colored boy, S. Robinson, also 11 U. S. cans, one bucket, one dipper, two tin syphons and two pieces hose. Men went out about 6 P. M. returning about 11 P. M. with 250,000.

May 13.—Clear. Wind heavy from N. W. Sent 300,000 young fish to be placed in river above Havre de Grace, at 9 A. M. Launch returned at 12 M., bringing bbl. containing lanterns and a package from Register & Sons. Permitted A. Hamlen to go to Baltimore to see his brother, who had been seriously injured by an explosion of old shells. Turned out 250,000 young fish in narrows, at 5 P. M. Obtained 200,000 eggs at night, and would probably have gotten more had it not been for heavy wind, which prevented gillers from going out.

May 14.—Clear and cold. Heavy wind from N. E. Sent 270,000 young fish above Havre de Grace at 9 A. M. Mr. J. A. Ryder returned in launch. Wind moderate at night and men went out, obtaining 300,000 eggs. Arranged a laboratory for Prof. Ryder. Mr. Heywood reported for duty.

May 15.—Clear and cold. Sent 215,000 young fish above Havre de Grace. Received by mail a draft for $100.00 for incidental expenses. Sent Mr. Davenport and Mr. Simmons to Washington, as ordered. Men went out at 6 P. M. and returned with 750,000 eggs. Large number of female fish found, but very few males.

May 16.—Clear and pleasant. Had a great many visitors during the day. Sent men out at night and they returned with 275,000 eggs. Small launch arrived from Washington about 11 P. M., in charge of Capt. I. Poplein, who reported as having been detained by heavy winds.

May 17.—Clear and warm. Prof. Ryder went up to Batteries to examine spawn of perch, &c.

Was unsuccessful in getting any, but brought specimen of cat-fish caught at Osborne's battery. The Agent of the Pennsylvania Fish Commission arrived about 3 P. M. for young fish. Delivered to him 200,000 which we sent in steam launch to Pt. Deposit. Mr. Wright visited barges to see working of his new fish-hatching boxes. Found wire too coarse and had to carry them back. Men were very successful in obtaining eggs, procuring 780,000. This caused us to place a large number in cylinders, cones being full.

May 18.—Clear and pleasant. Sent the cat-fish obtained the day previous to Prof. Baird, at the Smithsonian Institution. It was pronounced an Albino. Mr. Heywood left at 8 P. M., having received a dispatch calling him home. Turned 250,000 fish in Narrows at 6 P. M. Obtained 420,000 eggs at night.

May 19.—Overcast, with wind from N. E. Sent 250,000 fish above Havre de Grace at 9 A. M. Obtained 600,000 eggs at night. Prof. Ryder busily engaged over the development of young fish.

May 20.—Clear and warm. Sent 275,000 young fish above Havre de Grace at 9 A. M., and 200,000 at 3 P. M. Eggs coming out rapidly. No room for them in cones, so had to use cylinders. Placed 200,000 young fish, from eggs obtained on 15th, off mouth of Swan Creek, at 6.30 P. M. Obtained about 640,000 eggs at night.

May 21.—Clear and heavy wind from S. E. Sent 350,000 young fish, from eggs taken on 15th, above Havre de Grace, at 10 A. M. Delivered to Pennsylvania Fish Commission 250,000 young fish at 3 P. M. Placed 50,000 in river near

Pt. Deposit, and 25,000 in Narrows. Heavy gale from S. E., preventing the obtaining of eggs.

May 22.—Overcast, with heavy gale from S. E., causing very high tide and salt water to back up in Narrows. Lost about 300,000 young fish from this cause. Sent dispatch to this effect to Maj. Ferguson. Sent 460,000 young fish above Havre de Grace. Rain about 3 P. M., wind shifting to N. W., changing about 5.30 P. M. to East. Grass giving us great trouble, it having been broken up by heavy wind, by getting in pipes, preventing an even flow of water to cones. Placed 550,000 young fish in cylinders, as ordered, to be kept for shipment. Received dispatch in regard to departure of Machinery Barge No. 2, from Baltimore. Obtained 540,000 eggs at night.

May 23.—Showery, with light winds during day. Machinery Barge No. 2 arrived about 5.30 P. M., and was moored safely alongside other barges. Obtained about 560,000 eggs at night. Informed Maj. Ferguson of arrival of barge by telegraph.

May 24.—Clear and warm. All hands at work early arranging barges. Sent Launch No. 2 to Havre de Grace at 9 A. M. for Maj. Ferguson, who arrived about 12 M., bringing Mr. Rettig, a machinist, with him, to arrange machinery on Barge No. 2. Maj. Ferguson returned at 5 P. M., leaving Mr. Rettig. Sent men to gather spawn. They returned, bringing only 100,000 eggs, and stated that the gillers would not allow them to examine their fish unless they received 50c. each for spawning fish. No doubt they would have obtained a very large number of eggs had they been allowed to examine fish, as a great many ripe ones were reported.

May 25.—Clear and warm. Sent dispatch to Maj. Ferguson in regard to action of gillers. Mr. Rettig left at 7 P. M. having arranged machinery of Barge No. 2. Sent to Havre de Grace for shipment, 1,750,000 young fish, which were turned over to Mr. Simmons. Also sent three men to assist in taking care of them. There were 41 cans and 5 large cylinders. Received dispatch from Maj. Ferguson in regard to gillers, offering as an inducement to allow us to examine their fish, the following prizes: $50.00 to giller furnishing greatest number of ripe fish, $25.00 to second and $10.00 to third. Also ordered A. Hamlen and Jones to Washton. This left me with a small force mostly new men and they only obtained 240,000 eggs at night.

May 26.—Clear and warm. Sent A. Hamlin and Jones to Washington, furnishing them with transportation order. Transferred cones and fish to new Machinery Barge. Obtained only 80,000 eggs at night. Men reported great scarcity of male fish.

May 27.—Clear and very warm. Had men at work cleaning up and arranging Barge No. 2.—Turned 1,070,000 young fish in Narrows, not having cans in which to transport them above Havre de Grace. Obtained only 100,000 eggs from same cause as before stated. Do not think the prize system will work well, as the gillers seem averse to allowing spawn &c. taken, to be used save in their own boats.

May 28.—Clear and warm. Strong wind from S. E. about 1, P. M. Simmons returned with cans, &c.

Only obtained 40,000 eggs at night.

May 29.—Cool and clear. Sent 100,000 young fish to be placed in Bush River. Launch returned about 12 bringing Capt. Tanner and Machinest Barry. Capt. Tanner spent day in examining arrangement of cones and working of outside cylinders. He left in 4 P. M. train. Troubled again with backing up of salt water and requested him to so inform Maj. Ferguson. Ordered tug to come down early in morning to move us. Received 4 reflecting lamps for Barge No. 2. Obtained 220,000 eggs at night.

May 30.—Cloudy and damp. All hands taking up anchors preparatory to moving above Havre de Grace. Got under way in tow of tug about 9.30 A. M. and anchored above Havre de Grace off Watson's Island in about 30 feet water at 12.30 P. M. Heavy S. W. wind all day. Sent men down to gather eggs at night and obtained 80.000. Rain and wind prevented gillers from going out.

May 31.—Clear and strong wind from N. W. Received 10 transportation orders, and dispatch ordering Simmons to Washington with all transportation cans on hand. Accompanied men down to gather eggs and returned with 500,000 at 11 P. M.

June 1.—Clear and pleasant. Received boxes containing jars &c. from Hatching house, Druid Hill Park. One of Winan and two of Ferguson jars broken. Prof. Ryder engaged most of day arranging for retardation of the hatching of shad eggs. Heavy storm with rain from N. W. about 7 P. M. Sent men to Battery whence they returned at 10.30 P. M. with

180,000 eggs. The storm prevented gillers from casting. Great scarcity of male fish reported.

June 2.—Cloudy and light rain during the forenoon. Engaged Collins and Myrtle from Havre de Grace to assist in taking spawn as directed by Maj. Ferguson. Sent men out at night and obtained 340,000 eggs. Scarcity of male fish prevented their doing better.

June 3.—Clear and pleasant. Machinist Barry busily engaged arranging machinery and engine. Went to Pt. Deposit accompanied by Prof. Ryder to examine specimen of fish reported caught there. It proved to be an Albino cat fish which we brought with us. Heavy squall with rain about 6.30 P. M. Very few gillers ventured out, so we only obtained 60,000 eggs.

June 4.—Clear and pleasant. Engine and machinery started about 5 P. M. working more regularly. Sent Prof. Baird the Albino cat fish by express by 9.52 train. Sent M. Gleason with 300,000 young fish on 12 M. train to Bush River. He returned at 4 P. M. Men obtained 680,000 eggs at night. They were placed in cylinder at 11 P. M.

June 5.—Overcast with heavy wind from S. Prof. Holman, a guest of Prof. Ryder's, arrived from Philadelphia. Had to stop engine on account of heavy sea, which interfered with cylinders. Prof's. Holman and Ryder accompanied spawn takers at night. Only obtained 160,000 eggs, the heavy sea running off the battery, preventing gillers from casting. Placed 485,000 young fish in river.

June 6.—Clear and pleasant. Machinery &c., moving smoothly. Prof. Holman left at 6 P. M.

Obtained 440,000 eggs which were placed in cylinders at 10.30 P. M.

June 7.—Clear and very warm. Cylinders working nicely and fish hatching rapidly. Placed 55,000 young fish overboard. Obtained 640,000 eggs at night, of which I placed 25,000 in Wright's boxes to hatch.

June 8.—Clear and pleasant. Gave Machinist Barry permission to go to Wilmington, Del., on business. Placed 650,000 young fish overboard. Eggs hatching out a greater proportion in cylinders than in cones. Obtained 220,000 eggs at night.

June 9.—Overcast and cool. Went to Havre de Grace with Prof. Ryder to weigh roe of shad, and found by calculation it contained at least 225,000 eggs. Maj. Ferguson, Mr. Stone of Cal., and Mr. Herbert Gill, arrived on 11.30 A. M. train. Mr. Gill engaged in settling accounts during day and left at 5.45 P. M., Maj. Ferguson and Mr. Stone leaving at 2.12 P. M. Obtained about 220,000 eggs at night. Large falling off in catch of fish reported.

June 10.—Raining. Capt. Tanner arrived at 12 M. Spent morning in examining construction of boats suitable for spawn taking. He left on 4.30 P.M. train for Wilmington, Del. Obtained 380,000 eggs at night.

June 11.—Clear and pleasant. Discharged Courtney and Hardy at their own request. Received dispatch to send fish to Baltimore. It was afterwards countermanded and one received to send 1,000,000 fish to Perryville, for shipment to Maine on 12th. The time for gilling having expired by law on the 10th, and having received orders not to send out after that date, obtained no more eggs. Very few men gilling and few fish taken.

June 12.—Clear and intensely warm. Thermometer at 9 A. M. 92°. Had all hands hard at work 1 P. M. taking up young fish for shipment. Terrific storm about 2.15 P. M. from N. W. with heavy rain, striking us with full force, causing us to break adrift and be driven ashore on bank of river. Lost 500,000 young fish overboard and 380,000 eggs nearly hatched; also, three anchors, chains, &c. Succeeded in getting 900,000 young fish safely to Perryville before the gale. Informed Maj. Ferguson by telegraph the result of the storm. Cleared away about 6 P. M. and had all hands at work hauling barges off. This we succeeded in safely doing at high-water, 11.30 P. M., and moored them safely alongside "Cochran's Ice House Wharf."

June 13.—Clear and very warm. Spent day fixing up. Had heavy squall and rain from N. W., about 4 P. M.

June 14.—Cool and pleasant. Maj. Ferguson arrived at 11.30 A. M. and returned at 1.30 P. M. Cast off from Ice House wharf and anchored in stream, as directed, at 6 P. M. Forwarded iron pieces, &c., to Maj. Ferguson, by express. Prof, Ryder left for Washington at 2 P. M.

June 15.—Raining. Discharged Captains Poplin and Farr, machinist Barry, engineers Woodland and Jeffries, and spawn-takers Freedy, Fletcher, Bailey, Mittendorff and Myrtle, whose accounts I forwarded Mr. Gill. Sent by express to Perry & Jones, cylinder with bottom &c., as ordered by Maj. Ferguson. Engaged most of day taking inventory of barge No. 2, and sent all bed linen &c., to be washed.

June 16.—Clear and pleasant. Light shower during afternoon. Sent hoisting engine to Washington, as ordered by dispatch. Took inventory of barge No. 1, and had paint &c., on sleeping barge all washed.

June 17.—Clear and pleasant. Sent Launch up and obtained $\frac{1}{8}$ cord wood. The day was spent in cleaning up &c. Washing returned at night.

June 18.—Clear and pleasant. Received five large boxes from Washington to store blankets &c., which we did, leaving full list inside.

June 19.—Clear and pleasant. Day spent in clearing up.

There was nothing done afterwards but the sending of two of barges to Baltimore, in tow of Taylor's tug, and the remaining two left at wharf at Harve de Grace with Launch, in charge of M. Gleason, machinist Flynn, and fireman Spillman, of U. S. N.

RECORD OF OBSERVATIONS made at Spesutie Narrows, on the U.
by Jno. S.

DATE.		TEMPERATURE OF—									DEPTH OF WATER AT STATION.	WIND.		
Day of Week.	Day of Month.	Air.	Surface Water.	Bottom.	Air.	Surface Water.	Bottom.	Air.	Surface Water.	Bottom.		Direction.	Intensity.	Direction.
		7 a.m.			12 m.			7 p. m.				7 a. m.		12
Monday	3											S. W.	Strong	S. W.
Tuesday	4	60	65	63	72	66	63	65	66	63	15 to 25 ft.	S. W.	"	"
Wednesday	5	62	65	63	73	66	63	72	65	65		N. E.	"	E.
Thursday	6	61	64½	65	81	67	67	72	67	67		S. W.	"	N. W.
Friday	7	64½	65	65	79	68	68	64	67	67		S. E.	Gentle	S. E.
Saturday	8	63	65	64	68	68½	67	75	70	69		"	"	W.
Sunday	9	63	67	67	83	71½	69	79	72	72		S.	Calm	S. W.
Monday	10	73	69½	69½	83	72½	71½	78	73½	73½		"	Gentle	S.
Tuesday	11	71	71½	71½	81	73	72½	79	73½	73½		S. W.	"	S.S.W.
Wednesday	12	66	70½	70½	73	69	71	72	73½	73½		N.W.	Strong	N. W.
Thursday	13	61	68	67	62½	70	69	61	69	69		"	High	"
Friday	14	58	64	64	63	67	65	61	67	66		N.	"	N. E.
Saturday	15	52	60	60	60	64	64	63	65	64		N. E.	"	"
Sunday	16	62	61½	61½	72½	64	63½	76	66	65½		N.W.	Strong	S.S.W.
Monday	17	63	64½	64	85	67	65½	77	68	68		W.	Gentle	N. W.
Tuesday	18	70	67	66	82	71	71	79	72	71½		S. W.	Light	S. E.
Wednesday	19	61	67	66½	82	70	68	75	72	71½		N. E.	"	N. E.
Thursday	20	71½	69	69	85	73	71	80	72½	71½		"	"	"
Friday	21	73	71	71	80	73½	73	79	74½	74½		S. E.	Strong	S.
Saturday	22	73	71	69	81	73½	73½	69	74	74		S. W.	"	S. W.
Sunday	23	68	72	72	74	72½	72½	69	73½	73½		E.	Light	S. E.
Monday	24	71	73	73	85	75	74	80	75	75		N. E.	"	"
Tuesday	25	76	74	74	86	77	76½	82	79	79		S. W.	"	"
Wednesday	26	76	77½	78	95	82	79½	83	82	81½		"	"	S. W.
Thursday	27	83	80	79½	95	80	79½	87	82	81½		"	"	"
Friday	28	79	79	79	87	80½	80½	73	80	79½		W.	"	S. E.
Saturday	29	68	76	76	85	78	78	70	77	77		N. E.	Strong	E.
Sunday	30	73	76	76	70	78	78	68	76	76	35 to 40 ft.	S. E.	"	S. W.
Monday	31	73	76	76	83	77	76	80	77	77		N.W.	"	N. W.
Tuesday	June 1	73	73	72½	80	77	75	74	75	74		S. E.	Light	S. E.
Wednesday	2	58	74	74	80	74	74	76	72	72		N.W.	Strong	N. E.
Thursday	3	63	72	71½	86	69	68	78	71	71		"	Light	N. W.
Friday	4	72	71	70	84.	71	71	80	71	71		"	"	N. E.
Saturday	5	69	74½	74	77	75	74	74	72	71½		S. E.	"	S. E.
Sunday	6	73	74	73½	78	74	73½	76	72	71½	35 to 40 ft.	S. W.	Strong	S. W.
Monday	7	84	74	74	89	77	75	79	75½	75		N.W.	Gentle	N. W.
Tuesday	8	75	73½	73	87	79	77	75	78	76		N. E.	Light	N. E.
						3 pm								
Wednesday	9	68	76	76	79	77	76	71	77	76		N. E.	Light	S. E.
Thursday	10	67	76	75	72	74	74	69	74	73		S. E.	"	"
Friday	11	64	72	71½	71	72	71½	80	73	72		"	"	"
Saturday	12	82	74	73½	92	79	77	82	78	76		N.W.	"	N. W.
Sunday	13	83	78	76	92	79	78	80	79	78		S. W.	"	S. W.
Monday	14	75	79	77	81	79	77	73	77	75		N.W.	Strong	N. W.
Tuesday	15	64	76	72	65	75	71	65	74	70		N. E.	"	E.

FISH AND FISHERIES.

S. Fish Commission Barges, from May 3d, 1880, to June 15th, 1880, Saunders.

	WIND.		CONDITION OF—				STATE OF—		
Intensity.	Direction.	Intensity.	Sky.	Sky.	Sky.	Water.	Tide.	Tide.	Tide.
m.	7 p. m.		7 a. m.	12 m.	7 p. m.		7 a. m.	12 m.	7 p. m.
Strong	S. W.	Gentle	Clear	Clear	Clear	Cloudy	Ebb	Ebb	Flood *a*
Gentle	"	"	"	"	"	"	"	"	"
"	S. E.	"	Cloudy	Cloudy	"	Clear	Flood	"	"
Strong	N. W.	"	Clear	Clear	"	"	"	"	"
Gentle	S. E.	Strong	Overcast	"	"	"	"	"	"
"	S. W.	Gentle	"	"	"	"	"	Slack	Ebb
Strong	"	"	"	"	"	"	"	Flood	"
"	S. S. W.	Strong	"	"	"	"	Slack	"	"
"	W.	Gentle	"	Overcast	"	"	Ebb	"	"
Gale	"	Gale	Clear	Clear	"	"	"	"	" *b*
High	N.	High	"	"	"	Muddy	"	"	"
Strong	N. E.	"	"	"	"	"	"	"	"
"	W.	Gentle	"	"	"	"	"	"	"
"	S. W.	"	Smoky	"	"	Clear	"	"	"
"	"	"	Clear	"	"	"	"	"	"
Light	S. E.	Light	"	"	"	"	"	"	"
"	N. E.	"	Rain	"	"	"	"	Slack	"
Strong	S. E.	Strong	Overcast	"	"	"	Flood	Ebb	Flood
"	"	"	Clear	"	"	"	"	"	"
"	E.	Light	Overcast	"	"	"	"	"	" *c*
Light	N. W.	"	"	Showery	"	"	"	"	"
"	S. W.	"	Clear	Clear	"	"	"	"	"
"	"	"	"	"	"	"	"	"	"
"	"	"	"	"	"	"	Ebb	Flood	Ebb
"	S. E.	"	"	"	"	"	"	"	"
Strong	N. W.	"	"	Overcast	"	"	"	"	" *d*
Gentle	S. E.	"	"	"	Cloudy	"	"	"	"
"	S. W.	"	Cloudy	Rain	Rain	"	"	"	" *e*
Strong	S. E.	"	Clear	Clear	Clear	"	"	"	"
"	N.	Strong	"	Overcast	Squall	"	"	"	"
"	N. E.	"	Raining	"	Clear	Muddy	"	"	"
"	N. W.	"	Clear	Clear	Stormy	"	"	Slack	"
Light	N. E.	Light	"	"	Clear	"	Flood	Ebb	"
Strong	S. E.	High	Overcast	Overcast	"	Clear	"	"	Flood
High	S. W.	Light	Clear	Clear	"	"	"	"	" *f*
Light	N. W.	Gentle	"	"	"	"	"	"	"
"	E.	"	Clear	"	"	"	"	"	"
Light	S. E.	Gentle	Overcast	Overcast	Overcast	Clear	Slack	Ebb	Flood
"	N. W.	"	Rain	"	Rain	"	Flood	"	"
"	S. W.	"	"	Clear	Clear	"	"	"	Ebb
"	"	"	Clear	"	"	"	"	Flood	" *g*
"	N. W.	"	"	"	"	"	Ebb	"	" *h*
"	"	"	"	"	"	"	"	"	"
Strong	N. E.	Strong	Raining	Raining	Raining	"	"	"	" *i*

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a. No thermometer to take temperature.
b. Very low tide.
c. Very high tide and water brackish. Rain about 3 p. m.
d. Rain about 5 p. m.
e. Moved barges to Watson's Island, above Havre de Grace, on account of salt water, at 10 a. m.
f. Very little tide; caused by river backing it down.
g. Terrible storm at 2.15 p. m., with terrific wind, causing barges to go adrift, losing 3 anchors and be driven high on rocks ashore.
h. Moved alongside Cochran's ice house wharf, having lost anchors in gale.
i. Heavy N. E. storm all day.

Md. COMMISSION OF FISH AND FISHERIES.

RECORD OF HATCHING OPERATIONS *conducted at Spesutie Narrows, Md., on the U. S. Barges, from 3d May, 1880, to 10th May, 1880, by Jno. S. Saunders.*

DATE.		SOURCES WHENCE FISH WERE OBTAINED.		FISH TAKEN BY—				RIPE FISH.		EGGS OBTAINED.	LOSS.		FISH HATCHED.	FISH DEPOSITED IN LOCAL WATERS.	FISH DEPOSITED IN OTHER WATERS.
DAY OF WEEK.	DAY OF MONTH.	Total length of haul-seines visited.	Total length of gill-nets visited.	HAUL-SEINES. No. Shad.	HAUL-SEINES. No. Herring.	HAUL-SEINES. Lbs. Rock.	GILL-NETS. No. Shad.	Males.	Females.		Eggs.	Fish.			
		Fathoms.	Fathoms.												
Monday	3	1,860		220	20,000			4	2	40,000	30,000		10,000	*a* 10,000	
Tuesday	4	1,860		354	15,000	250		19	13	275,000	25,000		250,000	250,000	
Wednesday	5	2,060	850	396	30,800		38	13	9	190,000	27,000		163,000	163,000	
Thursday	6	3,610		464	26,000			33	20	475,000	75,000		400.000	400,000	
Friday	7	3,610		689	36,300	24		26	17½	420,000	175,000		245,000	*b* 245,000	
Saturday	8	2,600	2,200	258	23,000		316	49	30½	600,000	60,000		540,000	540,000	
Sunday	9		2,150				271	21	15	300,000	30,000		270,000	270,000	
Monday	10	2,010	225	201	8,835	49	11	16	11½	230,000	15,000		215,000	*c* 215,000	
Tuesday	11	1,110	1,825	199	650	20	110	11	10	200,000	10,000		190,000		*d* 200,000
Wednesday	12		3,425				230	17	13	260,000	25,000		235,000	*e* 225,000	
Thursday	13		1,750				159	19	13	220,000	10,000		210,000	*f* 210,000	
Friday	14		2,100				316	26	17	345,000	20,000		325,000	*g* 325,000	
Saturyday	15		4,900				329	57	40	790,000	40,000		750,000	*h* 750,000	
Sunday	16		2,350				232	24	17	340,000	15,000		325,000	75,000	*i* 250,000

a. Eggs badly impregnated and a great many taken too young.

b. 150,000 eggs lost, by some one dropping coal oil in cone. Placed 10,000 young fish out in the Narrows, from eggs taken on 3d.

c. Placed 413,000 fish out in Spesutie Narrows on evening of 10th, hatched from eggs taken 4th and 5th.

d. Placed 250,000 fish in Spesutie Narrows. Placed 150,000 fish in above Havre de Grace, from eggs taken on 6th. Delivered to Mr. Creveling on 17th.

e. Placed 100,000 fish in Spetsutie Narrows. Placed 145,000 fish above Havre de Grace, from eggs taken on 7th.

f. Placed 190,000 eggs in Spesutie Narrows. Placed 300,000 above Havre de Grace, from eggs taken on 8th. Shad taken very hard and not yielding full number of eggs.

g. Placed 270,000 above Havre de Grace, from eggs taken on the 9th.

h. Placed 215,000 above Havre de Grace, from eggs taken on 10th. Shad taken small and not yielding full number of eggs. Scarcity of males reported by some of men taking spawn.

i. On 21st delivered to Mr. Creveling.

MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF HATCHING OPERATIONS conducted at Spesutie Narrows, Md., on the U. S. Barges, from 3d May, 1880, to 18th May, 1880, by Jno. S. Saunders—Continued.

DATE.		SOURCES WHENCE FISH WERE OBTAINED.		FISH TAKEN BY—				RIPE FISH.		EGGS OBTAINED.	LOSS.		FISH HATCHED.	FISH DEPOSITED IN LOCAL WATERS.	FISH DEPOSITED IN OTHER WATERS.
				HAUL-SEINES.			GILL-NETS.								
DAY OF WEEK.	DAY OF MONTH.	Total length of haul-seines visited.	Total length of gill-nets visited.	No. Shad.	No. Herring.	Lbs. of Rock.	No. Shad.	Males.	Females.		Eggs.	Fish			
		Fathoms.	Fathoms												
Monday	17	2,010	3,195	172	748		380	53	39	780,000	20,000	300,000	760,000	*k* 460,000	
Tuesday	18		2,650				167	24	21	420,000	40,000		*l* 380,000	240,000	*m* 140,000
Wednesday	19		3,150				252	40	30	600,000	40,000		560,000		*n* 560,000
Thursday	20		3,300				249	40	32	640,000	40,000		600,000		*o*
Friday	21		2,100				180	30	24	480,000	30,000		450,000		*p*
Saturday	22		2,925				219	33	27	540,000	15,000		525,000	*q* 525,000	
Sunday	23		2,575				257	33	26	560,000	15,000		545,000	545,000	
Monday	24		700				38	7	5	100,000	25,000	75,000	75,000	*r*	
Tuesday	25		1,900				131	14	12	240,000	90,000		150,000	1,050,000	*s* 150,000
Wednesday	26		825				52	6	4	80,000	60,000		20,000	*t*	
Thursday	27		1,000				143	5	5	100,000	70,000	50,000	30,000	*u*	
Friday	28														
Saturday	29		1,400				169	13	11	220,000	10,000		210,000		*w* 210,000
Sunday	30		400				50	6	4	80,000	5,000		75,000		*x* 75,000

k. Delivered to Commissioner of Fisheries of Pa. 200,000 young fish at 6 P. M. from eggs taken 11th and 12th. Lost 300,000 young fish by salt water being backed up by heavy S. E. storm on 21st. *l*. Placed in cylinder overboard on 22d, to keep as per Maj. Ferguson's order. *m*. Placed 225,000 young fish in Spesutie Narrows about 6 P. M., from eggs taken on 12th. *n*. Placed 250,000 young fish above Havre de Grace from eggs taken on 13th and 14th, at 10 A. M. *o*. Placed 285,000 young fish above Havre de Grace from eggs taken on 14th, at 10 A. M. Placed 200,000 young fish above Havre de Grace from eggs taken on 15th. Placed 200,000 young fish in Swan Creek from eggs taken on 15th. *p*. Placed 350,000 young fish above Havre de Grace from eggs taken on 15th. Placed 50,000 young fish above Havre de Grace from eggs taken on 16th. Delivered 25.000 young fish to Pa. Commissioner on 16th. *q*. Placed 460,000 young fish above Havre de Grace from eggs of 17th. *r*. Strike among gillers for 50c. apiece for ripe fish, which accounts for few eggs taken. Placed 240,000 young fish in Narrows from eggs of 18th. *s*. Sent to Havre de Grace for shipment 1,750,000 young fish from eggs of 18, 19, 20 and 21st. Great scarcity of male fish reported. *t*. Eggs taken very bad, being badly impregnated by scarcity of males. Lost good quantity by new hatching boxes of Mr. Wright. *u*. Placed out in Narrows 1,070,000 young fish from eggs of 22d and 23d. Could not send above Havre de Grace for want of cans. Eggs badly impregnated. *w*. Sent 150,000 young fish for distribution Bush River from eggs of 25th. *x*. Storm at night; few gillers out. **Moved Barges to Watson's Island on account of salt water at 10 A. M.**

MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF HATCHING OPERATIONS conducted at Spesutie Narrows, Md., on the U. S. Barges, from 3d May, 1880, to 18th May, 1880, by Jno. S. Saunders—Continued.

DATE.		SOURCES WHENCE FISH WERE OBTAINED.		FISH TAKEN BY—				RIPE FISH.		EGGS OBTAINED.	LOSS.		FISH HATCHED.	FISH DEPOSITED IN LOCAL WATERS.	FISH DEPOSITED IN OTHER WATERS.
				HAUL-SEINES.			GILL-NETS.								
DAY OF WEEK.	DAY OF MONTH.	Total length of haul-seines visited.	Total length of gill-nets visited.	No. Shad.	No. Herring.	Lbs. of Rock.	No. Shad.	Males.	Females.		Eggs.	Fish.			
		Fathoms.	Fathoms												
Monday	31		2,100				229	27	25½	510,000	25,000		485,000	485,000	
Tuesday	1		675				58	10	9	180,000	20,000		160,000	*y* 160,000	
Wednesday	2		2,700				179	20	17	340,000	40,000		300,000	300,000	
Thursday	3		400				45	3	3	60,000	5,000		55,000	*b* 55,000	
Friday	4		3,000				210	37	34	680,000	30,000		650,000	*c* 650,000	
Saturday	5		1,700				62	12	8	160,000	20,000		140,000	*d* 140,000	
Sunday	6		1,825				241	29	22	440,000	40,000		400,000	*e* 400,000	
Monday	7		4,600				557	40	32	640,000	40,000		600,000		*f* 600,000
Tuesday	8		1,400				52	13	11	220,000	20,000		200,000		*g* 200,000
Wednesday	9		1,580				91	17	11	220,000	20,000		200,000	100,000	*h* 100,000
Thursday	10		2,400				86	24	19	380,000	20,000		360,000	360,000	
		2,0730	48,201	2,953	161,333	343	6,109	871	660	13,355,000	1297,000	425,000	12,058,000	9,148,000	2,485,000

y. Heavy storm preventing many gillers from going out. *b.* Heavy squall preventing gillers from laying out. *c.* Placed 285,000 young fish in Bush River from eggs taken on 29th and 30th May. *d.* Lost out in river 485,000 young fish by overflow of cylinders and break in wire bottom, from eggs of 31st May. Heavy gale from S. W. preventing gilers going out. *e.* Placed in river 460,000 young fish, from eggs of 1st and 2nd. *f.* Placed in river 55,000 young fish, from eggs of 3rd. *g.* Placed in river 650,000 young fish, from eggs of 4th. *h.* Placed 140,000 young fish in river from eggs 5th.

Placed 400,000 young fish on flats opposite Watson's Island on 12th, from eggs of 6th.

Shipped 900,000 young fish at 2 P. M. on 12th to go to Maine, from eggs of 7th, 8th and 9th.

Turned out 100,000 young fish, which were intended to be shipped to Maine, but storm prevented.

Had terrific storm on 12th at 2:15 P. M., causing barges to drag anchor, and (break chains of three) causing us to lose eggs of 10th, which were nearly out and barges to go ashore.

RECORD OF DISTRIBUTION OF SHAD *made from May 7th,* 1880, *to June 27th,* 1880, *by Maryland Fish Commission under direction of T. B. Ferguson, Commissioner.*

DATE OF LEAVING STATION.		DATE FISH PLACED IN STREAM STOCK'D		NUMBER OF FISH.					TRIB-	
Day of Week.	Day of Month.	Day of Week.	Day of Month.	Originally Taken	Actually Planted	STATE.	PLACE.	STREAM.	UTARY OF	TRANSFER IN CHARGE OF
Friday	May 7	Friday	May 7	10,000	10,000	Md.	Spes'c Nar.	Susquen'a	C. Bay	Jno. S. Saunders
Saturday	" 8	Saturday	" 8	335,000	335,000	"	Wash, D.C.	E. br. Pot.	Pot'c	Wm. P. Sauerhoff
Saturday	" 8	Saturday	" 8	300,000	300,000	"		Patuxent	C. Bay	C. W. Schuermann
Sunday	" 9	Sunday	" 9	50,000	50,000	"	Wash, D.C.	E. br. Pot	Pot'c	Wm. P. Sauerhoff
Monday	" 10	Monday	" 10	413,000	413,000	"	Spes'c Nar.	Susquen'a	C. Bay	Jno. S. Saunders
Tuesday	" 11	Tuesday	" 11	250,000	250,000	"	"	"	"	" " "
Tuesday	" 11	Tuesday	" 11	150,000	150,000	"	H. de Grace	"	"	" " "
Tuesday	" 11	Tuesday	" 11	110,000	110,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Tuesday	" 11	Tuesday	" 11	200,000	200,000	"		Patuxent	C. Bay	W. H. Jenkins, Jr.
Wednesday	" 12	Wednesday	" 12	145,000	145,000	"	H. de Grace	Susquen'a	"	Jno. S. Saunders
Wednesday	" 12	Wednesday	" 12	100,000	100,000	"	Spes's Nar.	"	"	" " "
Thursday	" 13	Thursday	" 13	190,000	190,000	"	"	"	"	" " "
Thursday	" 13	Thursday	" 13	350,000	350,000	"	H. de Grace	"	"	" " "
Friday	" 14	Friday	" 14	270,000	270,000	"	"	"	"	" " "
Saturday	" 15	Saturday	" 15	215,000	215,000	"	"	"	"	" " "
Saturday	" 15	Saturday	" 15	60,000	60,000	"		Potomac	"	C. W. Schuermann
Saturday	" 15	Saturday	" 15	300,000	300,000	"	Cumberla'd	Potomac	"	H. E. Quinn
Sunday	" 16	Sunday	" 16	20,000	20,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Sunday	" 16	Sunday	" 16	300,000	300,000	"	Savage	Patuxent	C. Bay	Newton Simmons
Monday	" 17	Monday	" 17	100,000	100,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Monday	" 17	Monday	" 17	300,000	300,000	"	Pt. of Rocks	Potomac	C. Bay	J. F. Ellis
Tuesday	" 18	Tuesday	" 18	200,000	200,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Tuesday	" 18	Tuesday	" 18	225,000	225,000	"	Spes'c Nar.	Susquen'a	C. Bay	Jno. S. Saunders
Wednesday	" 19	Wednesday	" 19	250,000	250,000	"	H. de Grace	"	"	" " "
Thursday	" 20	Thursday	" 20	400,000	400,000	"	Wash, D.C.	E. br. Pot.	Pot'c	Sauerhoff & Hamlen
Thursday	" 20	Thursday	" 20	285,000	285,000	"	H. de Grace	Susquen'a	C. Bay	Jno. S. Saunders

RECORD OF DISTRIBUTION OF SHAD *made from May 7th*, 1880, *to June 27th*, 1880, *by Maryland Fish Commission under direction of T. B. Ferguson, Commissioner.*—Continued.

Date of Leaving Station		Date Fish Placed in Stream Stock'd		Number of Fish.						
Day of Week.	Day of Month.	Day of Week.	Day of Month.	Originally Taken.	Actually Taken.	State.	Place.	Stream.	Tributary of	Transfer in Charge of
Thursday	May 20	Thursday	May 20	200,000	200,000	Md.	H. de Grace	Susquen'a	C. Bay	Jno. S. Saunders
Thursday	" 20	Thursday	" 20	200,000	200,000	"	Swan Creek	"	"	" " "
Friday	" 21	Friday	" 21	350,000	350,000	"	H. de Grace	"	"	" " "
Friday	" 21	Friday	" 21	50,000	50,000	"	"	"	"	" " "
Friday	" 21	Friday	" 21	25,000	25,000	"	Spes'c Nar.	"	"	" " "
Friday	" 21	Friday	" 21	200,000	200,000	"	Wash, D.C.	E. br. Pot.	"	Sauerhoff & Hamlen
Friday	" 21	Friday	" 21	600,000	600,000	"	Savage	Patuxent	"	J. F. Ellis
Saturday	" 22	Saturday	" 22	460,000	460,000	"	H. de Grace	Susquen'a	"	Jno. S. Saunders
Saturday	" 22	Saturday	" 22	600,000	600,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Saturday	" 22	Saturday	" 22	200,000	200,000	"		Potomac	C. Bay	Sauerhoff & Hamlen
Sunday	" 23	Sunday	" 23	25,000	25,000	"		"	"	" "
Monday	" 24	Monday	" 24	800,000	800,000	"	Wash, D.C.	E. br. Pot.	Pot'c	Clark & Schuermann
Monday	" 24	Monday	" 24	240,000	240,000	"	Spes'c Nar.	Susquen'a	C. Bay	Jno. S. Saunders
Tuesday	" 25	Tuesday	" 25	400,000	400,000	"	Wash, D.C.	E. br. Pot.	Pot'c	F. N. Clark
Tuesday	" 25	Tuesday	" 25	500,000	500,000	"	Moxley's Pt	Potomac	C. Bay	Sauerhoff & Hamlen
Tuesday	" 25	Tuesday	" 25	1,050,000	1,050,000	Del.	Seaford	Nanticoke	"	N. Simmons
Tuesday	" 25	Tuesday	" 25	500,000	500,000	Md.	Savage	Patuxent	"	C. W. Schuermann
Wednesday	" 26	Wednesday	" 26	500,000	500,000	"	Moxley's Pt	Potomac	"	Sauerhoff & Hamlen
Wednesday	" 26	Wednesday	" 26	1,500,000	1,500,000	"	Laurel	Patuxent	"	C. J. Huske
Wednesday	" 26	Wednesday	" 26	400,000	400,000	"	Wash, D.C.	E. br. Pot.	Pot'c	C. W. Schuermann
Thursday	" 27	Thursday	" 27	450,000	450,000	"	"	"	"	F. N. Clark
Thursday	" 27	Thursday	" 27	1,070,000	1,070,000	"	Spes'c Nar.	Susquen'a	C. Bay	Jno. S. Saunders
Friday	" 28	Friday	" 28	75,000	75,000	"	"	"	"	" " "
Friday	" 28	Friday	" 28	150,000	150,000	"	Wash, D.C.	E. br. Pot.	Pot'c	F. N. Clark
Saturday	" 29	Saturday	" 29	150,000	150,000	"		Bush Riv.	C. Bay	Newton Simmons
Saturday	" 29	Saturday	" 29	50,000	50,000	"	Deer Park	L. Yong'g	Yon'g	S M. Rixey

RECORD OF DISTRIBUTION OF SHAD *made from May 7th*, 1880, *to June 27th*, 1880, *by Maryland Fish Commission under direction of T. B. Ferguson. Commissioner.*—Continued.

DATE OF LEAVING STATION		DATE FISH PLACED IN STREAM STOCK'D		NUMBER OF FISH.						
Day of Week.	Day of Month.	Day of Week.	Day of Month.	Originally Taken.	Actually Planted.	STATE.	PLACE.	STREAM.	TRIBUTARY OF	TRANSFER IN CHARGE OF
Saturday	May 29	Saturday	May 29	200,000	200,000	Md.	Wash, D.C	E. br Pot.	Pot'c	F. N. Clark
Tuesday	June 1	Tuesday	June 1	30 000	30,000	"	Wash, D.C.	E. br. Pot.	Pot'c	F. N. Clark
Wednesday	" 2	Wednesday	" 2	50 000	50,000	"	Off Wat. It.	Susquen'a	C. Bay	John S. Saunders
Wednesday	" 2	Wednesday	" 2	275,000	275 000	"	Moxley's Pt	Potomac	"	W. P. Sauerhoff
Thursday	" 3	Thursday	" 3	285,000	285 000	"		Bush Riv.	"	M. Gleason
Friday	" 4	Friday	" 4	485,000	485,000	"	Off Wat It.	Susquen'a	"	John S. Saunders
Friday	" 4	Friday	" 4	500,000	500 000	"	Little Falls	Potomac	"	Frank N. Clark
Friday	" 4	Friday	" 4	175,000	175 000	"	Wash. D.C.	E. br. Pot.	Pot'c	" " "
Saturday	" 5	Saturday	" 5	600 000	600,000	"	Little Falls	Potomac	C. Bay	Wm. H. Jenkins, Jr.
Saturday	" 5	Saturday	" 5	300,000	300,000	"	Wash. D.C.	E. br. Pot.	Pot'c	F. N. Clark
Sunday	" 6	Sunday	" 6	460,000	460,000	"	Off Wat. It.	Susquen'a	C. Bay	John S. Saunders
Sunday	" 6	Sunday	" 6	300,000	300 000	"	Wash, D.C.	E. br. Pot.	Pot'c	F. N. Clark
Monday	" 7	Monday	" 7	55,000	55,000	"	Off Wat. It.	Susquen'a	C. Bay	John S. Saunders
Monday	" 7	Monday	" 7	375,000	375 000	"	Savage	Patuxent	"	S. M. Rixey
Tuesday	" 8	Tuesday	" 8	650,000	650,000	"	Off Wat. It.	Susquen'a	"	John S. Saunders
Tuesday	" 8	Tuesday	" 8	400,000	400 000	"	Little Falls	Potomac	"	S. M. Rixey
Wednesday	" 9	Wednesday	" 9	140,000	140,000	"	Off Wat. It	Susquen'a	"	John S. Saunders
Wednesday	" 9	Wednesday	" 9	100 000	100 000	"	Ft. Wash'n	Potomac	"	Wm. P. Sauerhoff
Saturday	" 12	Saturday	" 12	400,000	400,000	"	Off Wat. It.	Susquen'a	"	John S. Saunders
Saturday	" 12	Saturday	" 12	100,000	100 000	"	" " "	"	"	" " "
Saturday	" 12	Saturday	" 12	75,000	75,000	"	Wash. D.C.	E. br. Pot.	Pot'c	F. N. Clark
Saturday	" 12	Saturday	" 12	500,000	500 000	"	Little Falls	Potomac	C. Bay	W. H. Jenkins, Jr.
Sunday	" 13	Sunday	" 13	175,000	175 000	"	Used for ex	periments		F. N. Clark
Sunday	" 13	Sunday	" 13	300,000	300,000	"	Wash, D.C.	E. br. Pot.	Pot'c	" " "
Monday	" 14	Monday	" 14	85,000	85,000	"	Used for ex	periments		" " "
Friday	" 18	Friday	" 18	50,000	50,000	"	Used for ex	periments		" " "

RECORD OF DISTRIBUTION OF SHAD *made from May 7th*, 1880, *to June 27th*, 1880, *by Maryland Fish Commission under direction of T. B. Ferguson, Commissioner.*—Continued.

DATE OF LEAVING STATION.		DATE FISH PLACED IN STREAM STOCK'D		NUMBER OF FISH.						
Day of Week.	Day of Month.	Day of Week.	Day of Month.	Originally Taken.	Actually Planted.	STATE.	PLACE.	STREAM.	TRIBUTARY OF	TRANSFER IN CHARGE OF
Saturday	June 19	Saturday	June 19	100,000	100,000	Md.	Used for ex	periments		F. N. Clark
Tuesday	" 22	Tuesday	" 22	160,000	160,000	"	Used for ex	periments		" " "
Sunday	" 27	Sunday	" 27	100,000	100.000	"	Mov'd to S	m's. In. for	expri's	" " "
				23,498,000	23,498,000					

In order to insure the active co-operation of the gill-net fishermen, the U. S. Commissioner has for several years generously paid to the gillers fifty cents for each ripe female shad delivered immediately as it was taken from the net. The fish were invariably returned to the fishermen, after the eggs had been taken, and as this operation caused no perceptible injury to the fish, the premium was a strong incentive to the co-operation of the fishermen, as it was a source of considerable profit to them.

The Maryland Fish Commission has never consented to pay any thing for the privilege of taking spawn from captured fish, as it has considered it but just that the fishermen should co-operate in a work intended for their future benefit. The U. S. Commissioner, however, has made this contribution to the fishermen on the ground that a portion of the fish produced from these eggs were subject to be shipped to other waters; but as the forces employed by the two Commissions were operated as one and the work conducted jointly, the U. S. Commissioner has paid for all the spawn obtained from fish taken in the gill-nets.

As the work increased from year to year this premium for the ripe shad became a considerable tax on the U. S. Commissioner, and it was determined that the amount paid should be reduced to twenty-five cents for each spawning shad, and due notice was given to the gillers during the season of 1879 that such a reduction would be made the following season. Even this reduced premium was a very liberal compensation for the small trouble the gillers were put to. I was, therefore, both surprised and mortified when, in the midst of the season, the fishermen refused to allow not only those employed by the U. S. Commission, but those also of the Maryland State Commission as well, to take eggs from their fish.

This conduct on the part of the fishermen might have caused a very decided diminution in the number of fish turned loose in these waters, had not the U. S. Commissioner again come to our aid and satisfied the fishermen by offering them other inducements for furnishing ripe fish.

As this "strike," as it may be designated, took place in the very height of the season, the number of fish produced at this station was no doubt diminished by several millions.

I cannot but condemn the short-sighted policy which instigated such action on the part of our fishermen; for the results of the work—especially in this locality—have been such as to convince the most skeptical among them of our capacity to increase shad to a very marked extent, and thereby, to correspondingly increase their crop.

The number of young fish produced at the Havre de Grace station—notwithstanding the adverse conditions of the season, and the interruption of the work from the causes above mentioned—reached 12,058,000. Of these 9,148,000 were deposited in the Maryland waters and 2,485,000 transported to other waters by the U. S. Commission.

The details of the distribution of the fish produced at this station as well as those hatched at the Navy Yard, and on the Steamer "Lookout," will be found on page 43 *et seq.*

It will be seen that the number deposited in Maryland waters reaches the total aggregate of 23,498,000.

HERRING—*Clupeidæ.*

The commercial importance of this family, and the ease with which it can be increased in those localities where it is diminishing and re-established in streams from which it has entirely disappeared, mark it as an object not only of our care, but close consideration and study.

On the Atlantic coast of the United States occur nine fishes belonging to the herring tribe. Four of these, the sea-herring, a fish of much economic importance on both sides of the Atlantic, the menhaden, another fish of extreme importance from Maine to Virginia, the thread-herring and the round-herring, insignificant species of no particular value, are found solely in the sea. One, the mud-shad, or gizzard-shad, is found in brackish water, from Cape Cod to Florida, while four others live both at sea and in the rivers, and by their peculiar habit of breeding in the rivers and feeding at sea are of the utmost importance to the river fisheries. These are the shad, the hickory-shad, or tailor-herring, and the two species of river herring. The two species of river herring have, for many years previous to 1879, been considered as identical, or, to speak more exactly, although fishermen have had decided opinions that there were two different kinds, this fact had not been demonstrated to the satisfaction of naturalists. Recent observations, however, have demonstrated very satisfactorily that there are two species, which, besides presenting marked and characteristic differences, are very different in their habits. One of them, the gray-back herring of Massachusetts, the branch herring of the Chesapeake waters, the Gaspereau (*pomolobus vernalis*) of Canada, appears to enter the rivers earlier than the other species. In the Chesapeake, the schools are said to be smaller, and they spawn higher up in the creeks. The other species, the glut-herring of the Chesapeake, the black-belly of Massachusetts, also known to New England fishermen by the names "saw-belly," "Kyack," and "cat-thrasher" (*pomolobus æstivalis*), is later in its runs, and swims in larger schools near the mouths of the creeks. The name glut-herring, indeed is said to refer to the fact that the schools of fish are so large that they fill up or glut the mouths of small streams, as well as the markets of the vicinity, while, on the other hand, the name branch-herring has reference to the fact that the other species goes up to the heads of creeks or branches. The glut-herring seems to be more widely distributed at sea along the coast of the United States, and they are frequently taken in great quantities in the mackerel nets of the Gulf of Maine, as well as the pounds along the coast. The geographical distribution of the two species, as now understood, is quite different. Both species occur in the Chesapeake Bay and its tributaries, and both together as far north as the Bay of Fundy and perhaps the southern part of the Gulf of Saint Lawrence. The glut-herring, however, is found south of the Chesapeake, even as far as the Saint John River of Florida, while the branch-herring, under the name of Gaspereau, occurs the entire length of the Gulf of Saint Lawrence and throughout Lake Ontario. It is somewhat difficult to distinguish the two species by external characters, the best distinction being in the color of the lining of the abdomen, which is black in the glut-herring and gray in the branch-herring. The former is also distinguished by its elongated form, lower body, less elevated fins, smaller eyes, and the different proportions of the bones of the head. It may be interesting in this connection to note the statement of two careful observers in Massachusetts, at the same time remarking that the subject is not thoroughly understood, and that further investigations may bring to light still other species related to those already described.

In an account of the "Topography and History of Wareham, Mass." (*Coll. Mass. Hist. Soc., Vol. IV.*, 1875, *2d series, pp.* 294–296.) is the following account of the two species of alewives, or herrings, which is interesting, since it is the first recorded instance of any discrimination between them:—

"Of the alewife there are evidently two kinds, not only in size, but habits, which annually visit the brooks, passing to the sea at Wareham. The larger, which set in some days earlier, invariably seek the Weweantic sources. These, it is said, are preferred for the present use, perhaps, because they are the earliest. The second less in size, and usually called 'black backs,' equally true to instinct, seek the Ogawam." The "black back" here referred to is doubtless the "glut-herring" of the Chesapeake region.

Col. Theodore Lyman, in his report as Commissioner of Fisheries for Massachusetts for the year ending Jan. 1, 1869, gives the following results of observations in various rivers of Massachusetts: "The netters recognize several sorts and several runs of alewives. The *river herring* is a large variety, not much esteemed, and supposed to spawn in tidal water. These are always most numerous in streams that have bad fishways; because, when once they have spawned *below* a dam, the progeny are not inclined to go farther, and lie in tidal waters. Large shoals of these "sulkers" may be seen at Squawbetty, on Taunton Great River, or at the foot of the dam, on Mystic Pond. Then there are the *gray-backs* and the *black bellies*, which have all the marks of a distinct species. * * * * * *
The *black-bellies* appear later in the season than the *gray-backs*, and though smaller are, by reason of their fatness, more esteemed."

Whenever the opportunity has occurred I have caused the spawn of the herring to be taken, and have tried several experiments in order to secure the best methods for propagating them, and have succeeded in hatching many hundred thousand, which have been returned to our waters. But for reasons stated in my previous Reports, no special hatching station has been established for the propagation of this fish, but this is in the program of the future.

Figures of the several species of this family are given in order that their peculiarities of form may be carefully studied, for it is most advisable that those employed in the work of fish culture who undertake the propagation of the herring should be able to distinguish especially between the glut-herring (*pomolobus æstivalis*) and the branch-herring (*p. vernalis*): for if the opportunities of propagating the two be equal the former should most certainly be selected as the more valuable variety.

The difference in the spawning habits of these two species has no doubt contributed very materially to the disappearance of the glut-herring and the continued abundance of the branch-herring, the latter seeking more isolated localities, where they are less disturbed by the fishermen, than the former.

Although the catch of herring during the last season was unusually large, yet, unfortunately, it consisted principally of the branch-herring or the less valuable variety.

Col. McDonald reports that "on the Neuse the catch of branch-herring (*p. vernalis*), or wall-eyed, as it is called by the fishermen on that river, was unusually large; sometimes the catch of a drag-net was almost wholly of this species. The run of glut-herring was very small. On the Albemarle the same condition of things existed, the large proportion being of the *vernalis* and males, being much smaller than the glut-herring. On the Rappahannock the only considerable run of herring was the *vernalis*. These were largely male, and very small, requiring about 1100 to the barrel."

"On the Susquehanna there was a herring glut from the 1st to the 10th of May. These also were the *vernalis*, mostly males, and very small, as on the Rappahannock."

HATCHING HOUSE.

The fish hatched during the year 1879 had all been distributed by the 1st of January, 1880, with the exception of twelve thousand seven hundred (12,700) California salmon, and eight hundred and seventy-five (875) young carp. A few Penobscot salmon, land-locked salmon, and brook-trout, were left in the brick ponds adjacent to the hatching-house.

The water supplying these ponds is mainly received from the high-surface reservoir located on the hill to the west of the hatching-house, where it is exposed to the action of the sun and atmosphere and reaches a very high temperature during the heated term.

Hitherto we had found it impracticable to keep the salmonidæ in these small ponds except in comparatively cool summers. I determined, however, to make another effort to keep over the fish referred to, but am now satisfied that these ponds can be better utilized for the rearing of other varieties which do not require such cold water. Almost all of the fish reserved for this experiment died during the summer.

SALMON—*Salmo salar.*

There were also on hand at the hatching-house sixty thousand eggs of the Penobscot salmon, which commenced to hatch on the 10th of the month, the hatching being completed by the 15th of February, when all the young fish were free from the egg. As this variety had been so successfully introduced into the Delaware River, and a few adults had been taken in the Susquehanna River on their return from the ocean, I deemed it advisable to secure as many eggs as possible for the principal waters of Maryland, and the U. S. Commissioner generously furnished us with the sixty thousand above mentioned, for the waters of the Susquehanna and the Potomac, as it was thought best to put all the fish into the tributaries of these two streams. It was arranged with the Commissioners of Pennsylvania, therefore, that I should hatch at Druid Hill Park the fish intended for the Susquehanna River, and that they should be transported to the headquarters of the Susquehanna by that commission and deposited in the tributaries of that stream. In accordance with this arrangement, on the 23rd of March I delivered to Mr. J. P. Creveling, the agent of the Pennsylvania Commission, twenty-three thousand of these fish, being the yield of one-half of the eggs received, to be disposed of as above indicated. I approved of this arrangement, as I was satisfied that the upper waters of the Susquehanna could be more readily reached through the aid of the Pennsylvania Commissioners, who were familiar with the localities best suited for the salmon during their stay in the river, and that by placing them as high up the stream as was possible their chances of existence would be very much increased. The sources of the Potomac River and of its tributaries within the State were easier of access, and the distribution of the fish intended for that river was effected under the auspices of the Maryland Commission.

The fish produced from the above-mentioned 60,000 salmon eggs were deposited as follows:—

On	March	23	23,000	Upper Waters of Susquehanna	by J. P. Creveling
"	"	24	3,000	in the Monocacy	by Wm. H. Jenkins, jr
"	April	5	10,000	" N. Fork Potomac	by Wm Hamlen
"	"	6	10,000	" S. Fork Potomac	by Wm. H. Jenkins, jr
"	"	9	5,000	" Conococheague	by Wm. Hamlen
"	"	9	7,729	" Monocacy	by Wm. H. Jenkins, jr
Total.			58,729		

LAND-LOCKED SALMON.

On the 22nd of January a gift of twenty-five thousand (25,000) eggs of the land-locked salmon was received from the U. S. Commissioner, being part of a lot collected by him from Grand Lake stream, Maine. As this variety of the salmon family has lost its propensity for migrating to the ocean, its introduction into the streams and ponds of the State has been attempted, with special regard for those portions of the State which are drained by the tributaries of the Ohio River. The experiments tried with this fish in the ponds at Druid Hill Park would indicate that it is better adapted to withstanding extremes of heat than is any other variety of the same family. As it attains a larger size and grows more rapidly than the brook-trout its domestication in trout streams is much to be desired.

The disposition made of the fish produced from this lot of eggs is indicated in the accompanying table:—

RECORD OF DISTRIBUTION OF LAND-LOCKED SALMON *made from March 22d*, 1880, *to August 9th*, 1880, *by Maryland Fish Commission.*

Day of Month.	Number of Fish.	State.	Place	Stream.	Tributary of—	Fish Delivered to—
Mar. 22.	200	Md.	Buckeystown	Pond	Monocacy	Chas. S. Simmons.
April 5.	3000	"	Oakland	L. Yough	Potomac	Wm. Hamlen
" 15.	500	"	Buckeystown	Pond	Monocacy	Chas. S. Simmons.
" 18.	500	"	Pikesville	"	Gwynn's Falls	Thos. J. Meyer.
" 19.	500	"	Green Spring Val.	"	L. Roland	S. S. Clayton.
" 19.	500	"	Carrollton	"	Patapsco Falls	S. W. Wilderson.
" 20.	500	"	Oakland	"	Patuxent River	C. Francis Dixon.
" 20.	500	"	Baltimore	"	" "	G. W. Ridgely.
" 20.	500	"	Airy Hill	"	Gwynn's Falls	H. W. Graue.
" 20.	500	"	Baltimore	Trout Branch	Patuxent River	S. P. Easter.
" 21.	500	"	Unionville	Pond	Linganore Creek	Wm. G. Wilson.
" 22.	500	"	Wilna	Winter's Run	Bush River	Edw. Hollingsworth.
" 24.	500	"	Baltimore	Pond	Gunpowder	P. T. George.
" 26.	500	"	Near Catonsville	"	Gwynn's Falls	Jno. R. Long.
" 28.	500	"	Clearspring	Mill Dam	Potomac River	S. M. Reitzell.
" 28.	500	"	Bel Air	Pond	Bush River	Alex. M. Fulford.
" 30.	500	"	Eden	"	Patapsco River	Chas. E. Lanver.
May 1.	500	"	Baltimore	Patuxent River	Chesapeake Bay	W. H. Baldwin, Jr.
" 4.	200	"		Dripping Spri'g	Gunpowder	D. R. Howard.
" 6.	500	"	Long Green Val.	Pond	B. Gunpowder	Edw. F. Jenkins
" 8.	500	"	Norrisville	"	Deer Creek	J. Benson Gable.
" 11.	500	"	Frederick	"	Potomac	Danl. Mainhart.
" 13.	500	"	Mt. Pleasant	"	Monocacy	Martin Hoke.
" 14.	500	"	Denton	"	Choptank	Jas. E. Hignutt.
" 17.	500	"	Baltimore	"	Gunpowder	S. Baldwin.
" 18.	500	"	Fairview	Bush Run	Conocheague	Jos. C. Herschberger.
" 18.	500	"	Sulphur Spring	Pond	Patapsco	Henry Cragg.
" 24.	500	"	York Road	"	Gunpowder	Mrs. J. F. C. Talbott.

RECORD OF DISTRIBUTION OF LAND-LOCKED SALMON *made from March 22d*, 1880, *to August 9th*, 1880, *by Maryland Fish Commission*—Continued.

DAY OF MONTH.	NUMBER OF FISH.	STATE.	PLACE.	STREAM.	TRIBUTARY OF—	FISH DELIVERED TO—
May 27.	500	Md.	Sandy Spring	Pond	Patuxent River	Ernest Lawford.
" 27.	500	"	Sandy Spring P. O.	"	North West River	Geo. B. Miller.
	16,900					

CALIFORNIA SALMON—*Oncorhynchus quinnat.*

The experiments of hatching the eggs of the California salmon in floating boxes were renewed in the north branch of the Potomac at the point near its source, which had been selected the preceeding fall, and was attended with equally successful results.

About 200,000 eggs were obtained from the U. S. Commissioner of Fish and Fisheries. These were landed at Oakland and transported thence in a wagon to the point indicated, where they were hatched and the young fish protected until the sac was sufficiently absorbed, when they were liberated in the Potomac between the hatching station and Fort Pendleton.

An account of the work at this place in detail will be found in the accompanying table:—

MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF SALMON HATCHING OBSERVATIONS made at North Branch, on the Potomac River, from October 13th, 1880, to November 22nd, 1880, by E. H. Walke.

DATE.		TEMPERATURE OF									Depth of water at station	WIND.			CONDITION OF—			LOSS.		FISH HATCHED	REMARKS.
		7 a. m.			12 m.			5 p. m.													
Day of Week	Day of Month	Air	Surface Water	Bottom	Air	Surface Warer	Bottom	Air	Surface Water	Bottom		Direction	Direction	Direction	Sky	Water	Tide (River)	Eggs	Fish		
Wednesday	13	32	40	42	82	46	46	52	44	44	3 ft.	S. W.	S. W.	S. W.	Clear	Clear	Low	5881			*Had one Sal-
Thursday	14	20	38	38	70	42	42	58	46	46	3 ft.	N. E.	N. E.	N. E.	Clear	Clear	Low*	1525		1	mon to hatch out
Friday	15	50	42	42	72	48	48	60	48	48	3 ft.	S.	W.	W.	Cloudy	Clear	Low	673			after being in the
Saturday	16	58	46	46	68	50	50	62	48	48	3 ft.	S.	S.	S.	Clear	Clear	Low†	650			water one day.
Sunday	17	40	48	48	56	48	48	40	48	48	3½ ft.	E.	N. E.	S. W.	Cloudy	Clear	High	475		4	† Raining and
Monday	18	30	40	40	42	40	40	42	40	40	3½ ft.	N.	N.	N.	Clear	Clear	High	453		12	storming.
Tuesday	19	30	32	32	40	36	36	30	36	36	3 ft.	N.	N.	N. E.	Clear	Clear	Low‡	54		2	‡Snowing very
Wednesday	20	30	36	36	50	36	36	42	36	36	3½ ft.	N. E.	N. E.	N. E.	Clear	Clear	Low‖	350		6	hard.
Thursday	21	32	36	36	62	38	38	46	38	38	3½ ft.	E.	E.	S. E.	Cloudy	Clear	High	271		5	‖ River rising
Friday	22	32	38	38	66	38	38	50	38	38	3½ ft.	S.	S.	S.	Clear	Clear	High	243		7	very fast.
Saturday	23	30	35	35	32	35	35	30	35	35	3½ ft.	N. E.	W.	W.	Cloudy	Clear	High§	295		18	§Still continues
Sunday	24	32	35	35	36	35	35	36	35	35	3½ ft.	N. W.	N. W.	N. W.	Cloudy	Clear	High	305		22	to snow.
Monday	25	24	35	35	48	35	35	38	35	35	3½ ft.	N.	N.	N.	Clear	Clear	High	175	2	20	*River up very
Tuesday	26	35	35	35	48	35	35	48	35	35	3½ ft.	N. E.	N. E.	N. E.	Cloudy	Clear	High	140		15	high and still in-
Wednesday	27	40	38	38	42	38	38	46	38	38	3½ ft.	S.	S.	S.	Cloudy	Clear	High*	105	3	30	creasing; expect
Thursday	28	40	38	38	44	38	38	42	39	39	3½ ft.	S.	S.	S, E.	Cloudy	Clear	High	125		290	to have to move
Friday	29	38	40	40	60	44	44	48	44	44	5 ft.	S. W.	S. W.	S. W.	Cloudy	Clear	High	103	7	1203	boxes.

MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF SALMON HATCHING OBSERVATIONS *made at the North Branch, on the Potomac River, from October 30th,* 1880, *to November 15th,* 1880, *by E. H. Walke and A. Wroten.*

DATE.		TEMPERATURE OF—									Depth of water at station	WIND.			CONDITION OF—		R.	LOSS.		FISH HATCHED.	FISH DEPOSITED IN LOCAL WAT'S	REMARKS.
		7 a.m.			12 m.			5 p.m.														
Day of Week	Day of Month	Air	Surface Water	Bottom	Air	Surface Water	Bottom	Air	Surface Water	Bottom		Direction	Direction	Direction	Sky	Water	Tide	Eggs	Fish			
Saturday	30	48	44	44	54	44	44	50	44	44	4 ft.	S.	W.	W.	Cloudy	Clear	High	74	9	2,326		
Sunday	31	47	44	44	38	44	44	32	44	44	4 ft.	S. E.	"		"	"	"	67	15	10,276		
November																						
Monday	1	28	40	40	44	40	40	34	40	40	5½ ft.	W.	W.	W.	Clear	Clear	High	102	37	25,224		
Tuesday	2	27	38	38	48	38	38	38	40	40	4 ft.	W.	"	"	"	"	"	117	19	5,618		River up so high had to move the boxes for fear of losing them.
Wednesday	3	20	36	36	50	38	38	40	38	38	4 ft.	S. W.	S. W.	S. W.	"	"	"	93	13	7,482		
Thursday	4	42	38	38	58	40	40	48	40	40	4 ft.	S.	S. E.	S. E.	Cloudy	"	"	57	27	15,237		
Friday	5	34	40	40	60	40	40	50	40	40	4 ft.	N. E.	N. E.	N. E.	Clear	"	"	39	19	24,392		
Saturday	6	38	40	40	60	42	42	56	42	42	3 ft.	S.	S.	S. E.	Cloudy	"	Low	72	9	21,371		
Sunday	7	26	38	38	30	38	38	28	38	38	3 ft.	N. W.	N. W.	N. W.	"	"	"	47	10	28,382		
Monday	8	24	38	38	48	38	38	30	38	38	3 ft.	N.	N.	N.	Clear	"	"	36	13	31,673		
Tuesday	9	30	38	38	50	38	38	48	38	38	3 ft.	E.	E.	E.	"	"	"	67	15	8,252		
Wednesday	10	40	38	38	52	38	38	46	38	38	3 ft.	N. E.	N. E.	"	Cloudy	"	"	83	11	6,755		
Thursday	11	46	38	38	58	40	40	48	40	40	3 ft.	N. E.	"	N. E.	"		"	147	27	2,782		
Friday	12	34	38	38	50	38	38	36	38	38	3 ft.	N.	N.	N. W.	Clear	"	"	129	43	2,567	25,000	
Saturday	13	30	36	36	30	32	32	26	32	32	3 ft.	W.	"	N.	Cloudy	"	"	85	15	1,324		Snow 4 inches deep.
Sunday	14	22	26	26	29	32	32	26	28	28	3 ft.	W.	W.	W.	"	"	"	73	11	1,714	30,000	
Monday	15	20	28	28	26	28	28	20	28	28	3 ft.	S. W.	S. W.	S. W.	"	"	"	140	13	1,025	20,000	
																		13,251		198,035		

MD. COMMISSION OF FISH AND FISHERIES.

RECORD OF SALMON HATCHING OBSERVATIONS made at the North Branch, on the Potomac River, from Nov. 16th, 1880, to Nov. 22, 1880, by E. H. Walke.

DATE.		TEMPERATURE OF—									Depth of water at station	WIND.			CONDITION OF—			Fish	FISH DEPOSITED IN LOCAL WATERS.	REMARKS.
		7 a.m.			12 m.			5 p.m.												
Day of Week	Day of Month	Air	Surface Water	Bottom	Air	Surface Water	Bottom	Air	Surface Water	Bottom		Direction	Direction	Direction	Sky	Water	Tide (River)			
Tuesday	16	20	28	28	30	28	28	30	28	28	3 ft.	W.	W.	W.	Cloudy	Clear	Low	3	15,000	
Wednesday	17	22	30	30	32	30	30	30	30	30	3 ft.	S. W.	S. W.	S. W.	"	"	"	7	20,000	
Thursday	18	24	30	30	20	30	30	18	30	30	3 ft.	W.	W.	W.	"	"	"	5	30,000	Snow storm; wind blowing very hard.
Friday	19	10	30	30	24	30	30	20	30	30	3 ft.	"	"	"	Clear	"	"	11	20,000	
Saturday	20	20	30	30	28	30	30	22	30	30	3 ft.	"	"	"	Cloudy	"	"	115	15,000	
Sunday	21	10	30	30	26	30	30	12	30	30	3 ft.	"	N. W.	"	Clear	"	"	125		
Monday	22	10	30	30	22	30	30	16	30	30	3 ft.	"	W.	"	"	"	"	55	22,396	
																		639	197,396	

The experts in fish culture who visited this station during the development of the eggs, pronounced the eggs and young fish in the most healthy condition; and there was a marked differece between the appearance of the fish hatched in these pure cold waters and those hatched in the warmer waters of the hatching-house in Druid Hill Park.

I am convinced that by means of this system of moveable hatching apparatus our streams can be much better stocked with the salmonidæ than by the system hitherto pursued of developing the eggs in hatching-houses and transferring the young fish thence.

Colonel Hughlett, the Commissioner of Fisheries for the Eastern Shore, having received a like number of eggs from the U. S. Commissioner, the resources of the Druid Hill hatching-house were placed at his disposal for their proper care and development, it being also considered that Baltimore was the most convenient point for their distribution to the waters of his district, as the several lines of transportation centre in that city.

Ten thousand young fish of this lot were kindly turned over to me by Col. Hughlett, 5,000 of which were placed in the head waters of the Gunpowder River and the rest in the Patuxent near Savage Station. The few young California salmon hatched at the Druid Hill hatching-house, from eggs received in the fall of 1879 and reremaining on hand when the report of the operations of that year was submitted, were distributed, as shown in the following table, on January 6, March 9 and 25.

The table also shows the date on which the fish produced from the eggs hatched for Col. Hughlett were turned over to his messenger. The names of the streams stocked and the places at which they were deposited will no doubt appear in Col. Hughlett's report.

RECORD OF DISTRIBUTION OF CALIFORNIA SALMON, from January 6, 1880, to December 17, 1880, by Maryland Fish Commission under Direction of T. B. Ferguson, Commissioner.

Date.	No. of Fish.	Place of Deposit.	Stream Stocked.	Tributary of	Transfer in Charge of
January 6.	8,000	Keyser, W. Va.	Potomac River.	Chesapeake Bay.	Wm. H. Jenkins, jr.
March 9.	1,000	Sandy Spring, Md.	Pond.	Patuxent River.	Ernest Lawford.
" 25.	800	Buckeystown, "	Pond.	Monocacy "	C. S. Simmons.
Nov. 12.	12,000	Wat's East. Shore, "	Thos. Hughlett,	Commissioner.	Thos. Hughlett, jr.
" 13.	12,000	" " " "	"	"	" "
" 15.	18,000	" " " "	"	"	" "
" 17.	18,000	" " " "	"	"	" "
" 19.	18,000	" " " "	"	"	" "
" 23.	18,000	" " " "	"	"	" "
" 26.	12,000	" " " "	"	"	" "
" 29.	10,000	" " " "	"	"	" "
Dec. 1.	18,000	" " " "	"	"	" "
" 3.	10,000	" " " "	"	"	" "
" 16.	5,013	Phœnix, "	Gunpowder River.	Chesapeake Bay.	Wm. H. Jenkins, jr.
" 17.	5,014	Savage, "	Patuxent "	" "	" "
	165,827				

California Brook Trout—*Salmo iridea.*

During the two years preceding the last, a considerable number of the eggs of the brook trout were purchased and hatched out at the Druid Hill hatching establishment, and the young fry distributed to persons who were desirous of stocking their streams with this fish. The means at the disposal of the Commission did not warrant a further expenditure during the year 1880, and we are indebted to the liberality of the U. S. Commissioner for a supply of trout eggs obtained from the trout common to the streams of the Pacific slope. And as this member of the trout family not only grows more rapidly than the eastern species, but attains a larger size, and is found in much warmer waters than those inhabited by its cousin of the Atlantic states, I have deemed it of importance to attempt its introduction into the waters of Maryland.

Several consignments of these eggs received from the U. S. Commission were successfully hatched and were distributed under the same regulations that had been established for the distribution of the *salmo fontinalis.*

The accompanying tabulated statement of the distribution of the California trout will show the waters in which they were placed.

RECORD OF DISTRIBUTION OF CALIFORNIA TROUT *made from April* 15, 1880, *to August 9th*, 1880, *by Maryland Fish Commission.*

Day of Month.	Number of Fish.	State.	Place.	Stream.	Tributary of—	Fish Delivered to.
April 15.	500	Md.		Stream	Gwynn's Falls	J. S. Bull.
" 15	300	"	Buckeystown	Pond	Monocacy	Chas. S. Simmons.
" 16	500	"	Patuxent Station	2 Streams	Little Patuxent	J. T. Popplein.
" 17	500	"	Waverly	Stoney Run	Jones Falls	Henry R. Wilson.
" 17	500	"	Catonsville	Pond	Patapsco	L. Keidel.
" 17	500	"	Long Green Branch	Gunp'r River		Washington Shearman.
" 18	500	"	Pikesville	Stream	Gwynn's Falls	T. J. Meyer.
" 19	500	"	Green Spring Valley	Pond	Lake Roland	S. S. Clayton.
" 19	500	"	Carrollton	"	Patapsco	S. W. Wilderson.
" 20	500	"		Rocky Run	Patuxent	G. W. Ridgley.
" 20	500	"	Airy Hill	Stream	Gwynn's Falls	H. W. Graue.
" 20	500	"	Oakland	Pond	Patuxent R.	C. Francis Dixon.
" 20	500	"		Trout Branch	Patuxent	S. P. Easter.
" 21	500	"		Pond	Gwynn's Falls	H. C. Seymour.
" 21	500	"	New Market	Bush Creek	Monocacy	Dr. H. H. Hopkins.
" 21	500	"	Unionville	Pond	Linganore	Wm. G. Wilson.
" 21	500	"	New Market	Bush Creek	Monocacy	Wm. Downey.
" 22	500	"	Wilna	Plum Tree Run	Bush River	Edw. Hollingsworth.
" 22	500	"	Phoenix	Stream	Gt. Gunpowder	W. S. Carroll.
" 22	500	"	Near Phoenix	"	"	Henry H. Carroll.
" 22	500	"	Near Phoenix	"	"	Saml. S. Carroll.
" 26	500	"	Westminster	Pond	Pipe Creek	Samuel Roop.
" 26	500	"	Westminster	"	Patapsco River	Theo. F. Englar.
" 27	500	"	Arlington	Stream	Gunpowder	P. T. George.
" 27	500	"	Dripping Spring	Gunpowder	Patuxent	Jno. W. Quick.
" 27	500	"	Stream			D. R. Howard.
" 28	500	"	Clearspring	Frantz Mill Dam	Potomac	S. M. Reitzell.
" 28	500	"	Bel Air	Stoney Branch	Bush River	Alex. M. Fulford.

RECORD OF DISTRIBUTION OF CALIFORNIA TROUT *made from April* 15, 1880, *to August 9th*, 1880, *by Maryland Fish Commissioner*—Continued.

Day of Month.		Number of Fish.	State.	Place.	Stream.	Tributary of—	Fish Delivered to—
April	30.	500		Eden	Pond	Patapsco	Chas. E. Lanver.
May	1.	500		Anacostia, D. C.	"	Anacostia R.	W. Lee White.
"	1.	500		Baltimore	Stream	Patuxent R.	Wm. H. Baldwin.
"	3.	500		Uniontown	Pond	Big Pipe Creek	Theodore Eckard.
"	4.	500		White Hall	"	Gunpowder	Saml. W. Black.
"	4.	500			Stream		George Small.
"	7.	500		Govanstown	"	Back River	Saml. W. Regester.
"	8.	500		Norrisville	McDonald's Run	Deer Creek	Benson Gable.
"	11.	500	Md.	Frederick City	Pond	Potomac	Daniel Mainhart.
"	13.	500	"	Mt. Pleasant	"	Monocacy	Martin Hoke.
"	14.	1,000	U. S.	Fish Commission			J. F. Ellis.
"	15.	500	Md.	Baltimore	Pond	Gunpowder	John T. Streett.
"	17.	500	"	Warren	Gunpowder		Summerfield Baldwin.
"	18.	500	"	Sulphur Spring	Pond	Patapsco	Henry Cragg.
"	18.	500	"	Sykesville	Stream	W. Branch Potomac	Jos. Barlow.
"	18.	2,500	"	Fairview	Bush Run	Conococheague	Jos. C. Herschberger.
"	19.	500	"	Ijamsville	Pond	Monocacy	J. C. Riggs.
"	20.	500	"	Baltimore	Stoney Run	Jones' Falls	Thos. W. Sweeny.
"	21.	500	"	Ellicott City	Stream	Patapsco Falls	E. Scott.
"	21.	500	"	" "		" "	Edward Davis.
"	24.	500	"	York Road	Pond	Gunpowder	Mrs. J. F. C. Talbott.
"	25.	500	"	Greenwood	"	"	John W. Burton.
"	27.	500	"	Sandy Spring P. O.	Stream	Patuxent	George B. Miller.
"	29.	500	"	St. James	Pond	Gunpowder	J. M. Pearce.
"	29.	20,000	U. S.	Fish Commission			J. F. Ellis.
"	29.	5,000	Md.	Rockville	Rock Creek	Potomac	Saml. Robertson.
"	31.	500	"	Barnesville	Pond	Monocacy	F. P. Hays.
June	1.	500	"	Port Deposit	"	Susquehanna	F. S. Everist.

RECORD OF DISTRIBUTION OF CALIFORNIA TROUT *made from April* 15, 1880, *to August 9th*, 1880, *by Maryland Fish Commissioner*—Continued.

Day of Month.	Number of Fish.	State.	Place.	Stream.	Tributary of—	Fish Delivered to—
June 1.	500	Md.	Port Deposit	Pond	Susquehanna	Wm. Adams.
" 4.	500	"	Near Monrovia	"	Bennett's Creek	Levi Price.
" 14.	200	"	Dickerson	"	Potomac	Geo. R. Hays.
" 15.	500	"	Ijamsville	"	Bush Creek	J. C. Riggs.
" 24.	500	"		Stream	Western Run	Chas. Long.
" 26.	500	"	Bella Vista	Pond	Gunpowder	Lambert Gittings.
Aug. 9.	180	"	Southside Club, Long	Island		Wm. Hamlen.
	57,180					

THE CARP.

The supply of German Carp for 1879, derived from the increase of those which had been deposited with us by the United States Commissioner, enabled us to distribute during that year 6,135 young fish; which were given to such persons only as had ponds suitably prepared for their reception. The extraordinary success which had attended the cultivation of those previously issued having aroused a lively demand for these fish, the few hundred that were on hand at the opening of the year were all distributed by the middle of January—to the great disappointment of a large number of applicants, whose orders we were necessarily compelled to leave unfilled.

The Carp distributed throughout the State of Maryland are mostly of the two kinds known as the "Scale," and the "Leather" (or scaleless) varieties—the latter being the result of careful selection and breeding are held in somewhat higher esteem.

The Scale Carp, however, from which all our stock is derived, were imported by Professor Baird, some years ago, from the best ponds in Europe. They were so carefully selected by his agents, with reference to purity of stock, that they often produce individuals of the "improved," or "Leather," variety—young fish almost entirely destitute of scales being frequently found in the same brood with those holding more closely to the original type.

It is of interest, in this connection, to record the fact that the fish which have been distributed in the United States, as well as those retained in the breeding ponds at Druid Hill Park, and in the government ponds at Washington, have shown a most remarkable annual growth—greatly in excess indeed of what has ever been observed, for a corresponding length of time, in the case of those bred in their native waters.

This phenomenal development may be readily account-ed for, however, when we consider that the Carp not only find in our waters the greatest abundance of natural food, but that the comparative mildness of our climate permits them to feed through a much more extended portion of each year than is possible in Northern Europe, where long and rigorous winters condemn them to extended periods of hibernation.

The fact of such relative rapidity of growth has at least been clearly established, and affords a new evidence —as gratifying as it was unexpected—of the complete success which has rewarded the efforts of Prof. Baird to introduce this valuable fish into American waters.

Reverting to our narrative of operations for the year 1879, the ponds in Druid Hill Park were drawn early in May, all eels, frogs and fish inimical to the Carp found in them were destroyed, and a number of aquatic plants were set out to serve as food for the fish and as receptacles for their eggs.

On the 7th of the same month the breeding fish were placed in ponds Nos. 3 and 4—thirty-one Leather Carp being deposited in the former, and one hundred and three in the latter. A few Mirror Carp of varying sizes were also placed in pond No. 4, and a few young Carp in pond No. 1—our main dependence being, of course, the adult fish in ponds Nos. 3 and 4. The imported Golden Ides were still kept in pond No. 2.

Immediately after being returned to the ponds the fish commenced to spawn, and it is quite likely that the drawing of the water, and disturbance of the fish so near their spawning time, was so far detrimental to them that the yield for this year was somewhat decreased in consequence. A number of twigs and blades of water grasses on which the fish had deposited their eggs were taken from the large ponds, with the eggs attached, and were placed in the brick ponds adjacent to No. 2, which had been especially prepared with a view to the purposes of artificial breeding. In a few days the eggs commenced to hatch, and we soon obtained from them a considerable number of young fish. The large breeding ponds—in which the adult fish had been placed—were not disturbed again until late in the fall. During the summer the ponds were greatly depredated on by herring; kingfishers also occasioning us much annoyance, until the Park Commissioners kindly authorized the attendant to shoot these birds, when their ravages were somewhat abated.

As the attendant was necessarily compelled to be absent from the ponds for a considerable time each day, the kingfishers continued their depredations to a troublesome extent, until a plan for their destruction was suggested by Admiral Ammen, which, as it proved effective, I take pleasure in repeating here for the benefit of culturists whose ponds are subject to the raids of these feathered robbers. In accordance with his directions, several poles were placed upright around the edges of the ponds, each pole being armed at the top with a small steel-trap, set with quite a delicate "trip." The kingfishers and other predacious birds when approaching the ponds naturally select these poles to perch upon as affording favorable positions from which to scan the waters and fall upon their prey; they light, of course, upon the trap which springs to the touch, and either captures them or inflicts a fatal wound.

I am satisfied that the number of fish—especially of the Golden Ide—destroyed by these birds, before the war of extermination commenced, was very considerable, the brilliant color of the Ide making them very conspicuous objects in the water, at the same time that their habit of swimming near the surface renders them an easy prey to their enemies.

In order to secure the young Carp for distribution, we commenced to drain the ponds again on the 20th of October, and again freed them of eels, catfish and other enemies which had accumulated during the summer.

The Carp were immediately assorted, the larger ones being returned to the ponds, while those four or five months old were placed in tanks at the hatching house for distribution. Of the latter it was found that we had available for issue twenty-five thousand seven hundred and eighty-five (25,785) Scale Carp; eighteen hundred and sixty (1860) Leather Carp, and eighteen hundred and twenty-five (1825) Mirror Carp, a very large increase over the crop of the preceding year. The distribution was at once commenced and has been continued up to the present time.

The number of fish given to any one person in 1879 was limited to ten pairs, but the greater success which had attended our efforts at propagation during the summer of 1880, enabled me to increase the allotment for that year to twenty-five pairs to each person who applied for them at the hatching house, while a very favorable arrangement made with the "B. & O." and "Adams" Express Companies enabled me to transport the fish at small cost, and thus to distribute twenty pairs each to many persons living at a distance, who desired the fish, but could not conveniently call for them.

The following letter was mailed, prior to the distribution, to many prominent citizens throughout the State; and the attention of the public directed to the subject in various other ways:

MARYLAND FISH COMMISSION,
1327 "M" ST., WASH., D. C., *Nov.* 1, 1880.

Dear Sir:—

The propagation of the imported "Carp" at the breeding ponds in Druid Hill Park has been so successful this seaaon that I hope to be able to make a very large distribution of this most valuable fish to those persons in the State who desire to cultivate them, and I have made arrangements with the "Adams" and "Baltimore and Ohio" Express Companies which will enable me to supply the wants of applicants much more conveniently than heretofore.

Last season I issued to each applicant twenty (20) fish, but it was necessary for the parties desiring them to send to the hatching-house in Druid Hill Park for their respective quotas. I am happy to announce that I can now send the fish by Express, through the co-operation of the Companies above mentioned, to any of their stations. This arrangement will save applicants much trouble and expense. I would much prefer, however, to issue the fish at the ponds; and, in order to induce those wishing them to *come* for them, will issue *ten* fish, in addition to the usual number supplied, to those who come for them, and who thus relieve us of the necessity of shipping.

The number of fish that will be sent to parties desiring them will be fixed, for the present, at *forty.* The cost of wagoning to the station, express charges and return of the cans to the Druid Hill Hatching House, will be two dollars ($2.00), which amount will be collected by the Express Agent on the delivery of the fish. The parties receiving the fish must be provided with a vessel to which the fish can be transferred on their delivery. The number of transporting cans belonging to the Commission is limited ; and there is, of course, an urgent necessity for their prompt return.

I have received the most encouraging accounts of the success which has attended the cultivation of this fish by those who have hitherto been recipients of them ; and it bids fair to fill a want which has been much felt in this State. This fish is so admirably adapted for domestic purposes, that every one in the State who has even a small pond, such as is usually devoted to the collection of ice, should prepare it for rearing the carp, which being largely a vegetable feeder can be raised at very little expense, and can be utilized for the consumption of the waste of the kitchen and garden.

I trust that the arrangements which I have made will enable you and your neighbors to avail yourselves of the advantages presented by the introduction of this fish into the United States by Prof. Baird. Should you or any of your friends desire to have the carp sent, please address me as above.

I am very truly yours,
T. B. FERGUSON,
Commissioner.

In accordance with the arrangement already referred to, the Superintendents of the Express Companies issued the following instructions to their agents :

SUPERINTENDENT'S OFFICE,
BALTIMORE, MD., *Nov.* 1, 1880.

.... *Agent.*

"Several shipments of live fish will be made by the Commissioner of Fisheries to parties in the neighborhood of your station. In delivering them to the consignee, you will in no instance issue the vessels in which the fish are sent. The parties receiving the fish must provide vessels for their removal to the ponds.

A blank receipt will be forwarded with each shipment, and you are required to have the same filled up and signed by the consignee, and return the receipt to the Commissioner of Fisheries.

Should the fish not be promptly called for, you are requested by the Commissioner to change the water in the cans once or twice a day, or whenever the fish show signs of distress by coming up and remaining at the top of the water.

If the fish are not delivered within 5 days after their arrival, you will report the fact to this office and await instructions. After delivering the fish return the empty cans as soon as possible to this office, regularly way-billed FREE."

How widespread has been the demand for the Carp and the extent to which the Commission by satisfying that demand has enabled the people of the State to enter upon the important work of cultivating this valuable fish, may be ascertained in part by a perusal of the following tables, which show only the distribution made under my immediate direction, a large additional number having been turned over to my colleague, Col. Hughlett, for distribution in his neighborhood and not being included in this statement. As the supply of Leather Carp was considerably smaller than that of the Scale Carp, I secured from the U. S. Commission a number of the first named variety; and sixteen hundred (1600) of these, as well as two thousand Scale Carp from the ponds at Druid Hill Park, were turned over to Col. Hughlett to supply the wants of those who had applied directly to him:

RECORD OF DISTRIBUTION OF GERMAN CARP made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.

DATE.	NO. OF FISH ORIGINALLY TAKEN.	STATE.	PLACE.	STREAM.	TRIBUTARY OF	FISH DELIVERED TO
January 7	20	Md.	Glencoe	Pond	Gunpowder	Jos. W. Mowell
" 8	20	"	Baltimore	Lake	Stony Run	Thos. W. Levering
" 8	20	"	New Market	Pond	Bush Creek	Mrs. E. C. Shipley
" 8	20	"	" "	"	Linganore	John Burgess
" 8	20	"	" "	"	"	J. W. Dorsey
" 8	20	"	" "	"	Bush Creek	W. M. Downey
" 8	20	"	" "	"	Linganore	Dr. J. W. Downey
" 8	20	"	" "	"	"	John D. Shearer
" 8	20	"	" "	"	Bush Creek	Howard H. Hopkins
" 12	20	"	North Branch	"	Patapsco	William M. Baker
" 12	20	"	Spencerville	"	Potomac	Charles Righter
" 16	20	"	Westminster	"	Pipe Creek	Dr. Herring
" 16	20	"	Fountain Val	"	"	Fred. Zahn
" 16	20	"	" "	"	"	John Wolf
" 16	50	"	Frederick City	Monterin Lake	Monocacy	Charles J. Lewis
" 28	20	"	Baltimore	Pond	Patapsco	Felix McCurley
" 30	20	"	Bel Air	"	Winter's Run	P. Howard
February 7	20	"	Aberdeen	"	Swan Creek	John H. Orem
" 10	20	"	Harford Co.	"	Long Green	John T. Street
" 10	20	"	Trappe	"	Choptank	Jas. W. Long
" 10	20	"	Baltimore	"	Little Gunpowder	Ann Emory
" 11	20	"	Druid Hill Park	"	Jones' Falls	M. C. Barclay
May 6	20	"	Catonsville	"	Patapsco	L. Keidel
" 6	20	"	Long Green Val.	"	Big Gunpowder	Edw. F. Jenkins
" 7	20	"	Bel Air	"	Bush River	G. L. Van Bibber
" 7	20	"	" "	"	Bynim's Run	John Clayman
" 7	20	"	" "	"	Bush River	S. Archer
" 7	20	"	" "	"	Winter's Run	E. H. Webster

RECORD OF DISTRIBUTION OF GERMAN CARP made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.	No. of Fish Originally Taken.	State.	Place.	Stream.	Tributary of	Fish Delivered To
May 7	20	Md.	Bel Air	Pond	Winter's Run	P. Donnegan
“ 7	20	“	“	“	Bush River	H. Stump
“ 7	20	“	“	“	“	P. Howard
“ 7	20	“	“	“	Bynim's Run	Wm. S. Forward
“ 7	20	“	“	“	“	John S. Dallam
“ 7	20	“	“	“	“	L. Cahn
“ 7	20	“	“	“	“	H. W. Archer
“ 7	20	“	“	“	“	Geo. Y. Maynadyer
“ 7	20	“	“	“	“	Wm. S. Richardson
“ 7	20	“	Govanstown	“	Back River	Samuel W. Regester
“ 7	20	“	Airy Hill	“	Gwynn's Falls	W. H. Graue
“ 7	20	“	Ellicott City	“	Patapsco	W. A. Hammond
“ 7	20	“	Jessups	“	Patuxent	A. J. Gall
“ 8	20	“	Baltimore	“	Gunpowder	Geo. Appold
“ 8	20	“	“	“	“	M. Gill
“ 8	20	“	Dayton	“	Patuxent	James Harban
“ 10	20	“	Bel Air	“	Bush River	Alex. Fulford
“ 10	20	“	“	“	“	Andrew Katzmier
“ 10	20	“	“	“	“	Henry Fulford
“ 10	20	“	Rossville P. O.	“	Back River	Chas. Trump
“ 10	20	“	Carroll Co.	“	Pipe Creek	James Ogle
“ 10	20	“	Oakland Mills	“	Patuxent	Jno. W. Quick
“ 10	20	“	Caroline Co.	“	Choptank	W. Birkigt
“ 11	10	“	Frederick Co.	“	Potomac	Daniel Mainhart
“ 12	20	“	“	“	Linganore	Wm. F. Boland
“ 12	10	“	Contee's Sta.	“	Patuxent	F. K. Jenkins
“ 12	20	“	Brooklandville	“	Jones Falls	Rich. H. Woollen

RECORD OF DISTRIBUTION OF GERMAN CARP made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.		No. of Fish Originally Taken.	State.	Place.	Stream.	Tributary of	Fish Delivered To
May	12	10	Md.	Denton	Pond	Choptank	Jas. E. Hignutt
“	13	10	“	Highland	“	Patuxent	S. Hopkins
“	13	10	“	Baltimore	Grantly Brook	Susquehanna	G. W. Small
“	13	10	“	Still Pond	Pond	Still Pond Creek	Geo. R. Parrott
“	15	10	“	Greenwood	“	Gunpowder	Washington Shearman
“	17	10	“	Linden Sta.	“		Miss E. A. Calvert
“	17	10	“	“	“		C. B. Calvert
“	18	10	“	Mt. Airy	“	Linganore	J. B. Runkles
“	18	10	“	Baltimore City	“	Gwynn's Falls	H. C. Seymour
“	18	10	“	Sulphur Spring	“	Patapsco	Thos. S. Jeager
“	18	10	“	Woodford	“	W. br. Patapsco	Casper Erck
“	18	10	“	“	“	“	Joseph Barlow
“	19	10	“	Ijamsville	“	Monocacy	C. M. Riggs
“	20	10	“	Baltimore	“	Stoney Run	T. W. Levering
“	20	10	“	Sandy Spring	“	Patuxent	Charles F. Brooke
“	27	10	“	Carroll County	“	Grave Run	Dr. J. Weaver
June	4	10	“	Frederick County	“	Bennett's Creek	Levi Pierce
“	7	10	“	“Athol”	“	Patapsco	R. W. Rasin
“	8	10	“	A. A. County	“	Rhode River	James Boyle
July	22	19	“	Carroll County	“	Gunpowder	George Hoffacker
Oct.	28	50	“	Glencoe	“	“	Joseph W. Mowell
“	30	50	“	Clear Spring	“		E. H. Frantz
“	30	50	“	Forest Hill	“	Deer Creek	Andrew Reynolds
“	30	50	“	“	“	“	R. Tucker
Nov.	1	50	“	Near Waverly	“	Stony Run	Henry R. Wilson
“	2	50	“	Baltimore County	“	Bear Creek	Felix McCurley
“	2	50	“	Ellicott City	“	Patapsco	W. A. Hammond

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B Ferguson, Commissioner.—Continued.

DATE.		NO. OF FISH ORIGINALLY TAKEN.	STATE.	PLACE.	STREAM.	TRIBUTARY OF	FISH DELIVERED TO
Nov.	2	50	Md.	Bel Air	Pond	Bush River	Alex. M. Fulford
"	3	50	"	Elkridge Landing	"	Patapsco	W Mackintosh
"	3	75	W. Va.	Old Sweet Spring	"		O. Beime
"	5	50	Md.	Kome	"	Jones' Falls	William W. Shirley
"	9	50	"	Prince George	"	Bear branch	Thomas R. Coward
"	9	50	"	Baltimore County	"		H. C. Tiesch
"	9	50	"	Cedar Hill	"		J. M. Hawkins
"	9	50	"	Phœnix	"	Big Gunpowder	T. V. Richardson
"	10	50	"	Taylor	"	Little Gunpowder	Dr. E Emory
"	10	50	"	"	"	"	Mrs. Ann Emory
"	10	50	"	Oakland, Balt. Co.	"	Jones' Falls	G. H. Forster
"	10	50	"	Dayton	"	Patuxent	James Harban
"	10	40 L*	"	Frostburg	George's Creek	Potomac	T. G. McCulloh
"	10	50	"	Baltimore County	Pond	Patuxent	H. C. Seymour
"	10	20	"	Harford County	Lake	Susquehanna	G. W. Small
"	10	4	"	"	"	"	G. W. Small. 1 year old
"	10	50	"	Baltimore County	Pond	Jones' Falls	A. J. Ulman
"	10	40 L	"	Gaithersburg	"		E. L. Tschiffely
"	11	40 "	"	Westminster	"		Hon. J. E. Smith
"	11	40 "	"	"	"		Wm. A. McKellup
"	11	50	"	Westminster	"	Little Pipe Creek	F. E. Cunningham
"	11	50	"	Highlands	"	Patuxent	B G. Cissel
"	11	1000	"				Thomas Hughlett, Com'r
"	11	50	"	Still Pond	Pond	Sassafras	J. W. Howard
"	11	50	"	"	"	"	W. B. Harboard
"	11	40 L	"	Oakland	"	L. Yonghiogheney	Dr. J. L. McComas
"	11	40 "	"	Colora	"		A. J. Michener

*Leather Carp.

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.	No. of Fish Originally Taken.	State.	Place	Stream.	Tributary of	Fish Delivered To
Nov. 11	50	Md.	McDonogh Inst.	Pond	Gwynn's Falls	Col. Wm. Allan
" 11	50	"	Baltimore County	"	Jones' Falls	Philip Bevann
" 11	50	"	Patuxent Sta.	"	L. Patuxent	J. T. Popplein
" 11	50	"	New Market	"	Haseld Run	Wm. E. Swormly
" 12	50	"	Near Sykesville	"	W. br. Patapsco	Joseph Barlow
" 12	50	"	"	"	"	John T. Ridgely
" 12	50	"	" Reisterstown	"	Patapsco	Col. William Norris
" 12	50	"	Brooklandwood	"	Jones' Falls	J. R. Mordecai
" 12	50	"	West Friendship	"	Middle River	John T. Roston
" 12	50	"	Woodstock	"	Patapsco	Samuel E. Davis
" 12	50	"	Flint Grove	"	Dry Seneca	John F. Fletchall
" 12	50	"	Franklintown	"	Gwynn's Falls	G. G. Page
" 12	50	"	River View	"	Broad Run	G. W. Spates
" 12	50	"	Beallesville	"	L. Monocacy	Leoindas Jones
" 12	20	"	Stoney Castle	"	Broad Run	Benjamin White
" 12	50	"	"	"	"	W. O. Rhodes
" 15	50	"	Frizzleburg	"	Monocacy	Frederick Zahn
" 15	50	"	"	"	"	John U. Zahn
" 15	50	"	"	"	"	S. P. Weaver
" 15	50	"	Westminster	"	"	David Reese
" 15	50	"	"	"	Patapsico	T. F. Englar
" 15	50	"	"	"	Monocacy	Samuel Roop
" 15	50	"	Lutherville	"	Jones' Falls	Andrew Reese
" 15	50	"	Rossville	"	Stemmer's Run	Charles Trump
" 15	50	"	"	"	"	J. Sewell Glenn
" 15	50	"	Frizzleburg	"	Monocacy	J. R. Rinehart
" 15	50	"	Pr. George's Co.	"	Patuxent	Alex. Wolle, Jr.

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.	No. of Fish Originally Taken.	State.	Place.	Stream.	Tributary of	Fish Delivered To
Nov. 16	50	Md.	Up. X Rds, Har. Co	Pond	Winter's Run	Joseph Ashton
" 16	50	"	Sandy Spring	"	Patuxent	Charles F. Brooke
" 16	50	"	Up. X Rds, Har. Co	"	L. Gunpowder	St. Clair Baldwin
" 16	50	"	Up. X Rds, Har. Co	"	L. Gunpowder	Silas Baldwin
" 16	50	"	"	"	"	William Baldwin
" 16	50	"	Sandy Spring	"	Patuxent	H. C. Hallowell
" 16	50	"	Brighton	"	"	Samuel Janney
" 16	50	"	"	"	"	H. T. Lee
" 16	50	"	Lewistown	"	Fishing Creek	George W. Miller
" 16	50	"	Sandy Spring	"	Patuxent	Francis Miller
" 16	50	"	Lewistown	"	Fishing Creek	Lewis E. Miller
" 16	50	"	Sandy Spring	"	Patuxent	Henry H. Miller
" 16	50	"	Spencerville	"	"	Warwick P. Miller
" 16	50	"	Olney	"	Potomac	Robert M. Mackall
" 16	50	"	Sandy Spring	"	"	B. D. Palmer
" 16	50	"	Fork P. O.	"	Gunpowder	W. H. Riddle
" 16	50	"	Spencerville	"	Patuxent	Robert M. Stabler
" 16	50	"	"	"	"	Asa M. Stabler
" 16	50	"	"	"	"	Caleb Stabler
" 17	50	"	Chrome Hill	"	Deer Creek	William Gladden
" 17	50	"	Oakland	"	Jones' Falls	F. L. Ruppert
" 17	500 L	"	Westminster	"	Patapsco	Forest and Stream Club
" 17	500	"	"	"	Potomac	" " "
" 18	50 L	"	Indian Landing	"	Severn	Mrs. P. R. Uhler
" 18	50 "	"	Round Bay	"	"	H. O. Hofman
" 18	50 "	"	Finksburg	"	Beaver Run	George W. Armacost
" 18	50 "	"	Baltimore County	"	Jones' Falls	M. M. Leimkuhler
" 18	50 "	"	Rogers' Sta	"	Gwynn's Falls	C. H. Hoffman

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.		No. of Fish Originally Taken.	State.	Place.	Stream.	Tributary of	Fish Delivered To
Nov.	19	50	Md.	Stonesville	Pond	Bear Branch	Jos. Bankard
“	19	50	“	“	“	“	L. D. Vance
“	19	50	“	Westminster	“	Meadow Branch	Jesse Sullivan
“	19	50	“	Westminster	“	Meadow Branch	Chas. Shaffer
“	19	50	“	“	“	Bear Branch	D. Baumgarden
“	19	50 L	“	Stonersville	“	Patapsco	J. F. Shades
“	19	40 “	“	Denton	“		Jas. Hignutt
“	19	40 “	“	“	“		T. Smith
“	19	40	“	Point of Rocks	“		George Souder
“	19	40	“	“ “ “	“		Thos. D. Bond
“	19	40	“	Gaithersburg	“	Seneca	Harry D. Cooke
“	19	40	“	Salisbury	“	Wicomico	Humphrey Humphreys
“	19	40	“	Uniontown	“		William H. Hoffmann
“	20	50	“	Farn Hill	“	Gwynn's Falls	J. R. Long
“	22	50	“	Baltimore county	“	Chesapeake Bay	Dr. C. E. Coates
“	22	50	“	“ “	“	Gwynn's Falls	P. Schlesinger
“	22	40	“	Denton	“	Choptank	J. W. Kerr.
“	22	40	“	Elkton	“		David Scott
“	24	50	“	Anne Arundel Co.	“	West River	J. Fred. Kremelberg
“	24	50	“	Union Bridge	“	Big Pipe Creek	A. E. Null
“	27	40	“	Johnsville	“		R. R. Buckly
“	27	40	“	Williamsport	“		Jonas Bell
“	27	40	“	Elkton	“		A. W. Mitchell
“	27	40	“	Union Bridge	“		Jas. W. Ogle
“	27	40	“	Frederick	“	Monocacy	Jno. H. Williams
“	27	50	“	Greenwood	“	Gunpowder	Wash. Shermann
“	27	50	“	Upper X Roads	“	“	Jas. D. Ball

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

Date.		No. of Fish Originally Taken.	State.	Place.	Stream.	Tributary of	Fish Delivered To
Nov.	29	50	Md.	Harrisonville	Pond	Patapsco	W. N. Shirley
"	29	50	"	"	"	"	J. A. Dickerson
"	29	50	"	Elllcott City	"	"	Jno. R. Clarke
"	30	50	"	Westminster	"	Monocacy	Jno. D. Roop
"	30	50	"	"	"	Patapsco	Jeremiah Schaffer
"	30	50	"	"	"	"	H. Haines
"	30	50	"	"	"	"	J. E. Shreve
"	30	50	"	"	"	Pipe Creek	J. Y. Diffenbaugh
Dec.	1	75	"	Walkersville	"	Monocacy	Hugh McAleer
"	1	100	"	Rohrerville	"	Potomac	J. E. Holmes
"	1	75	"	Rowlandsville	"	Octoraro	Jno. M. Rawlings
"	3	50	"	Sweet Air	"	L. Gunpowder	Wm. Bower
"	3	50	"	"	"	"	Dixon Brown
"	4	50	"	Towsontown	"	Western Run	Chas. B. McLean
"	4	50	"	"	"	Jones Falls	C. B. Slingluff
"	4	50	"	Sheppard Asylum	"	" "	E. Hermann
"	4	80	"	Ijamsville	"	Bush Creek	C. M. Riggs
"	4	50	"	Baltimore county	"	Patapsco River	O. R. Benson
"	6	50	"	Upper X Roads	"	L. Gunpowder	Jos. A. Heyghe
"	8	75	"	Kennedyville	"	Chester River	L. C. Justis, Jr.
"	9	50	"	Sappington	"	Towser's Branch	Jos. V. Follansbee
"	10	50	"	Rossville	"	Chesapeake Bay	J. T. Glenn
"	10	50	"	Anne Arundel	"	Magothy	Rev. F. Dalrymple
"	11	50	"	Sunnyside	"	L. Gunpowder	Dr. F. D. Mitchell
"	15	50	"	Dickerson	"	Monocacy	Geo. R. Hays
"	15	50	"	Monocacy	"	"	Otho T. Hays
"	15	50	"	"	"	"	David L. Specht

RECORD OF DISTRIBUTION OF GERMAN CARP, made from Jan'y 7th, 1880, to Dec. 28th, 1880, by Maryland Fish Commission, under direction of T. B. Ferguson, Commissioner.—Continued.

DATE.		NO. OF FISH ORIGINALLY TAKEN.	STATE.	PLACE.	STREAM.	TRIBUTARY OF	FISH DELIVERED TO
Dec.	17	100	Md.	Rossville	Pond	Back River	Chas. Trump
"	17	75	"		"		S. K. George
"	17	75	"	Mt. Airy	"		A. G. Davis
"	18	150	"	Charlotte Hall	"	Patuxent	Theo. Smoot
"	18	75	"	Harrisonville	"	Patapsco	Jno. S. Miller
"	18	150	"	Charlotte Hall	"	Patuxent	J. E. F. Shane
"	18	150	"	N'r Charlotte Hall	"	"	Fred. Wiley
"	18	150	"	Baltimore county	"	Jones Falls	F. Meyer
"	18	1000	"	For distribution on		Eastern Shore	Thos. Hughlett, Com'r
"	20	75	"	Point of Rocks			Benj. Moffett
"	20	75	"	Brethedsville			Daniel Wolf
"	24	150	"	Upper X Roads	"	Bush River	Chas. T. Scarff
"	24	100		" " "	"	"	Jno. B. Banister
"	24	75		N'r Union Bridge	"	Sam's Creek	Daniel Rinehart
"	24	75					Miss E. A. Calvert
"	28	100		Berlin	"	Snow Creek	Dr. Wm. Henry
		12768					

Although puplic notice had been given, early in the fall of 1879, that the fish could be had by applying for them at the hatching house, many persons neglected to make application until late in the following spring, when the supply had become exhausted, and much disappointment was experienced in consequence of our inability to meet these tardy demands. Fearing a repetition of this procrastination and that the farmers would again postpone sending for their fish until the last moment, I limited the early distribution, for 1880, to 25 pairs to each applicant; it being considered that, if properly cared for, that number would be adequate to the stocking of a very large extent of pond. As the season advanced, however, and the supply of fish remaining in hand was apparently in excess of what would be required to meet the prospective demand, the number given to each applicant was proportionally increased.

The Carp, as has been before remarked, grow much more rapidly in this country than in Europe, and it is quite likely that the fish issued during the winter of 1880 will spawn during the summer of 1882. If this should prove to be the case and the young fish thrive as well as there is every reason to expect they will do, it will not be very long before they will become plentiful in numbers in all the waters of the State.

As an indication of the success which has attended their cultivation in all parts of the United States, I make the following extracts from reports made by those who have received them:

KOSSE, LIMESTONE CO., TEXAS, *June* 28th, 1880.

Dear Sir :—

The German Carp sent Sam'l Bell and me last fall are doing as finely as any one could possibly ask. When they arrived there was very little water in our pond, so we put them in a well with about four feet of water in it, and connected the well with the tank by means of a small ditch, letting the tank water fill it up; the ditch was left open so that the water would not stagnate. We put five of them in the tank (or pond), and fed all of them on corn bread and vegetables that had seed, such as tomatoes, squashes, etc., all of which they ate. They seemed to like the squash best and preferred it baked. * * * * They are now about four inches wide and a foot long. Corn bread is their favorite diet, and by feeding them at the same place every day they become accustomed to look for it, and now all we have to do when we wish to look at them is to tie a piece of stale bread to a string and float it on the water, when they come up all around it and scramble for it as hogs do for corn. There are numerous parties in this neighborhood with good ponds who want to know whether they can get any this summer or fall. Please let me know at once as fish in this section are scarce and high, and the Carp seems to be *the* fish.

Yours truly, VOLNEY METCALF.

RIXFORD, FLA., *Aug.* 5, 1880.

Dear Sir:—

It will doubtless be a pleasure to you to learn that the Carp you furnished me with last November are doing finely. I ascertained on my return from Savannah with them, that my pond was not ready for their reception, owing to the fact that there were many more black-bass in it than I had supposed. I accordingly confined the Carp in a pen at the side of the pond, giving them water through holes in the side, covered with wire netting. A few weeks since I discovered that a portion of the netting had been displaced and some of them had escaped into the pond, and I then concluded to let them all into it, as I had nearly all the bass out. Their growth since that time has been simply marvelous.

Sincerely yours, GEO. C. RIXFORD.

HOWARD COUNTY., MD., *Oct. 9th*, 1880.

Dear Sir :—

* * * * I received from your assistant, at Druid Hill Park, ten of the Scale Carp in May last. They were then about three inches long, and in digging the pond larger in August, (3 mos. afterward,) I let the water off to catch them and put them in the smaller pond, when I was surprised to find them from seven to ten inches long.

I have no other fish in the pond, and as the ten have done so well would like very much to get some of the Smooth ones. * * * *

Yours truly, JOSEPH BARLOW.

COLUMBIA, S. C., *Oct.* 18, 1880.

Dear Sir :—

* * * * I have the most encouraging reports of the Carp distributed last November ; some are ten inches in length and weigh one pound.

A. P. BUTLER,
Comr. of Agriculture.

THE FISH COMMISSIONERS,
ROMNEY, W. VA., *Oct.* 29, 1880.

Dear Sir :—

I have been extremely anxious to secure some more Carp. It is the only fish in which our people seem to take interest, and affords speedy evidence of the importance of our work. Of those received last fall we retained twenty-six in the hatchery ponds. Have them all yet, some weighing considerably over a pound. I am, therefore, very thankful for your offer to let me have more, and write to inquire where I shall send for them. * * * *

Very truly yours, C. S. WHITE.

BEL AIR, HARFORD CO., MD., *Nov.* 1, 1880.

My Dear Sir :—

Through your kindness I received a few Carp from

Druid Hill hatching house the first of last May. At that time the fish were about three inches long and weighed about ½ oz. each. I caught some for our Agricultural Show on the 11th of October (last month). One of them weighed 2¼ lbs. All weighed 2 lbs. or more, and averaged over fifteen inches long. They have had no attention whatever. The pond is about half an acre or more, from one foot to six feet deep. Five of the fish taken from the pond looked so well developed that I think they will spawn next February, although you informed me that they would not spawn until they were two years old. * * * *

Yours truly, JOHN S. DALLAM.

RIXFORD, FLA., *Nov.* 1.

My Dear Sir :—

* * * * My Carp (which are of the Scale variety) continue to thrive splendidly, and are a marvel to all who see them—especially those who saw them when I first procured them in November last when they were only about three inches long—and who now compare them. Many of them are from fifteen to seventeen inches in length, and six to seven inches in breadth. They show no signs as yet of going into winter quarters, coming for their food regularly, and I hope to be successful in carrying them through the cool weather without their resulting to the old habit. * * * *

GEO. C. RIXFORD.

ROSSVILLE, MD., *Nov.* 3, 1880.

Dear Sir :—

Your esteemed favor received. I availed myself of your order last spring to get from the Fish House twenty (20) Carp. They are doing well and have grown finely. From their appearance they must be ten inches in length, and I will certainly procure my quota from the same place at the earliest opportunity. * * * *

Truly and respectfully yours, C. TRUMP.

GERMAN CARP IN TENNESSEE.

NASHVILLE, *Nov.* 25, 1880.

* * * *

The Carp distributed here last year are all doing remarkably well, but those entrusted to Dr. Callender, Superintendent of the Insane Asylum, have made phenomenal progress. When placed in the ponds of the Asylum grounds the fry did not exceed one and a-half inches in length, and they looked very puny. The other day he brought into town five of the smallest he could catch in order to show Col. Akers. These would weigh one and a-half pounds, and livelier or finer looking fish could not be seen. The Doctor could not say definitely if any of them had spawned this year, though, judging from their present condition, they certainly will next spring. Every care has been given, feeding regularly and not allowing any one to disturb them. They have become so tame as to come at call to be fed.

* * * * FOREST & STREAM.

J. H. D.

HOLLY SPRINGS, MISS., *Dec.* 4, 1880.

Dear Sir:—

* * * * One party to whom we gave some Carp last February put them in a small highland horse pond, and about a month ago took one out, which, he says, weighed over three pounds. Have not examined any other ponds stocked at that time, but will do so next spring. * * * *

Yours truly, WALLACE & McGOWAN.

ASTOUNDING GROWTH OF CARP.

It is a fact, that the Carp has grown faster in America than it does in its original home; but the most wonderful story comes from Georgia. A gentleman in Macon sends Prof. Baird the following slip, from a local paper, and vouches for its truth. It says: "Yesterday afternoon

Mr. E. Witkowsky, who owns the tan-yard on the old Confederate armory property, concluded to cut the dam and clean out the pond in order that he might introduce his new German Carp. The pond contained a large number of smaller fish, and among them Mr. Witkowsky hoped to find his four Carp, which had been put into the pond last May. He found three of the fish; but to his astonishment they were by actual measurement twenty, twenty-two and twenty-five inches in length respectively. The fourth escaped through the cut in the dam. These Carp were but two or three inches long when put in the pond, and their growth is remarkable." * * * *

FOREST & STREAM, *Dec.* 9, 1880.

ILLINOIS STATE FISH COMMISSION,
QUINCY, ILL., *Dec.* 14, 1880.

Dear Sir :—

* * * * During the high water of last summer a few of our Scaled Carp escaped from the pond into a little overflow near. I secured them again about ten days ago. One of them measured twelve and one half inches in length. * * * *

Yours truly, S. P. BARTLETT.

SPENCER, OWEN CO., IND., *Dec.* 26, 1880.

My Dear Sir :—

* * * * My five Carp went into winter quarters about Nov. 10th. I estimate their weight at that time at two and a quarter pounds. I regret I was not able to get some of your fall distribution. * * * *

With respect, C. FLETCHER.

" To one who has never witnessed such a thing before, it is an interesting sight to see fish assemble for their feed at the sound of a horn. Arthur O'Keefe has his lake stocked with the rare and valuable fish known as the German Carp, and the writer being on hand a few days ago was asked to step down to the lake and see the fish fed. Mr. O'Keefe's little boy, Johnny, gave a few blasts with a tin horn ; a handful of bread was scattered in the water, and the Carp appeared by the hundreds, eagerly seizing the bits of biscuit. This fish is quite gentle, seeming to care but little for our presence, and even coming slyly up to nibble at a biscuit held in the hand. Most of those which we saw were about five inches in length, though there are many both larger and smaller in the lake." * * * *

RANCOCAS STOCK FARM,
JOBSTOWN, BURLINGTON CO., N. J.,
January 10, 1881.

Dear Sir :—

Enclosed please find receipt for the thirty-three Carp sent me in the spring of 1879.

We put them in a pond of about four acres, about nine feet deep in the middle, muddy bottom. We did not see much of the fish during 1879, but this spring they appeared by millions. You cannot go anywhere around the pond and throw in a few crumbs of bread, but they would rise in clouds for it, from a little one just hatched to a fish 4 and 5 inches long. We gave them this season lettuce, cabbage and other vegetable matter ; also bread crumbs and boiled hominy. The larger fish—those that were put in for stock—we rarely see ; once in a while one will jump out of the water. I should judge that last fall they were about 10 inches long. They appear to remain closer to the bottom of pond than the small ones. Had much difficulty in killing off the snapping turtles, and large bull-frogs, with which the pond was filled. We found the large frogs would eat the fish. There are now enough for all men and reptiles. We cut holes in the ice on pond, and stick in a bundle of straw, for ventilation. This is the plan I am told they do in Germany.

Respectfully yours, P. LORILLARD.
J. W. GRISWOLD, *Agent.*

MELLENVILLE, *January* 10, 1881.

Dear Sir :—

I received thirteen small Carp (the size of my thumbnail) on the Sunday, 9th of May last, in good order, and immediately emptied them in my pond, which was not quite completed. They were out of sight in an instant; the bottom being $\frac{2}{3}$ clay and $\frac{1}{3}$ sand, so that it was constantly rolly. Some days after I noticed the pond was full of frogs, some of large size, and as the fish had not been seen I supposed they had destroyed them. I called upon Mr. Blackford, in N. Y., soon after, but he could give me no information. In the latter part of August, the season being very dry, I had the water let out of the pond, and set workmen to finish digging it out with horses and scrapers. After they had been at work several days, three dead carp were seen that had been hurt with the horses ; one of which I measured and was 10 inches long, and weighed over a pound. We then saw 9 remaining in the water that was but about 12 inches deep, in a small space in the centre of the pond, which we fed with crumbs of bread until the cold weather set in (in November), and the pond froze over with not more than 18 inches of water. When our work was complete, about Sept. first, I found my spring that had never been known to give out before, was so near dry as to give us but a small quantity of water, and I fear the ice has frozen so hard and tight that the fish will smother. The wonderful growth from 9th of May to 9th September—say 4 months—beats anything I ever saw or heard of.

I had intended to make report to you before, but did not want to report a failure. On the 23d of last September I was in Washington, and called at your residence to make my report in person and pay my respects, and was told you were out of town. I shall be pleased to be enabled to report favorably next spring, or as soon as the ic gives out.

Respectfully, DANIEL BIDWELL.

GROWTH OF CARP IN VIRGINIA.

GORDONSVILLE, VA., *February* 4, 1881.

COL. M. McDONALD,
Commissioner of Fisheries for the State of Virginia.

Dear Sir :—

The seventeen Carp which you gave me in the fall of 1879 are doing remarkably well. In October last I caught four of them to see what growth they had made. They weighed from two and three-quarters to nearly four pounds. The largest one only lacked about two or three ounces of weighing four pounds. I am satisfied that they are just the fish for the waters of Virginia, and am sure they are the only fish suited to our ponds. General Field put 25 Carp in my pond some time since, which I understand were intended for my brother who has lately built a very nice pond. I was not at home at the time and suppose General Field thought they were intended for me. I take great interest in the fish-culture, and am satisfied you are doing a very great good by distributing the young fish in the waters of Virginia. Wishing you great success and thanking you for your kindness, I am, yours, very truly,

H. C. BAKER.

MT. MORRIS, GREENE CO., PA., *Feb.* 15, 1881.

PROFESSOR SPENCER F. BAIRD.

Dear Sir :—

It will doubtless give you pleasure to learn that the ten Mirror Carp I got of you the first of last June are doing finely and their growth is wonderful. When I received them, they were from four to five inches in length, and when last seen I believe them to be fifteen to eighteen inches long. I failed to learn the sex when I was at Washington. I received your order late last fall for some fish at Pittsburg. At that time I was very low with imflammatory rheumatism, and failed to get them. I want to construct another pond of one acre, provided I can get the fish of you to stock it. I want the Scale or Leather Carp ; also a few Mirror Carp for the old pond. I shall await your answer before commencing my new pond. Hope to hear from you soon.

Yours truly, J. W. LONG.

EXTRACT FROM CIRCULAR 48 RETURNED BY JAMES G. FIELD, GORDONSVILLE, ORANGE CO., VA.

In the fall of 1879 I obtained from Col. McDonald of your office thirty-two German Carp. Sixteen of them were put in Mr. Baker's pond and sixteen in the pond of my mother-in-law, of which I have control. Last fall Mr. Baker found that his fish had developed very rapidly. He succeeded in catching three or four and found them to weigh from 1 to 3 lbs. Last month my daughter and a friend were fishing in the pond of my mother-in-law and caught one that weighed four pounds. Last spring I received from Col. McDonald a lot of the "Leather Carp," but I cannot report as to their development to the present time. Next month I will get a seine and make a full inspection of the ponds of Mr. Baker and of my own, and will, if you desire it, report fully the result. I should like very much to have copy of any book or books you publish, and if I can render any service to you, will most cheerfully do it. If you will pardon the suggestion, I will say, that I think the *small fry* you distribute should only be given to persons who have private ponds, and who will agree that when the fish are grown they will turn them into adjacent streams. The fish you send out, if put directly into streams and large ponds full of Chub fish, Perch, Cat, &c., will all be destroyed before they have sufficient size and strength to protect themselves or escape their enemies.

May 16th, 1881. JAMES G. FIELD.

The results of the experiments of the last two or three years have shown, conclusively, that the waters of

Maryland are admirably adapted to the cultivation of the Carp, and it may, therefore, be confidently expected that within a comparatively short time every farmer throughout the State will have one or more fish ponds, which will prove quite as much a source of pleasure and profit as is the familiar chicken-coop or pig-pen.

Although hitherto regarded as being essentially a fresh-water fish, it is quite likely that the Carp will thrive in brackish water as well. I would, therefore, earnestly recommend to those of our citizens whose surroundings prevent them from securing ponds of entirely fresh water, that they try, at least, the experiment of cultivating this fish in such water as they are able to control. It should also be borne in mind that the Carp is peculiarly well adapted to waters which are subject to very high degrees of temperature during the summer months; for, although it sturdily withstands the rigors of a Northern winter, it is even more at home in a warm climate; and the most favorable results have attended its introduction into our extreme Southern States.

As much of the success attainable in Carp culture must always largely depend upon the character of the ponds, and of the water with which they are supplied, proper care must of course be exercised in each case to obtain as favorable conditions as possible.

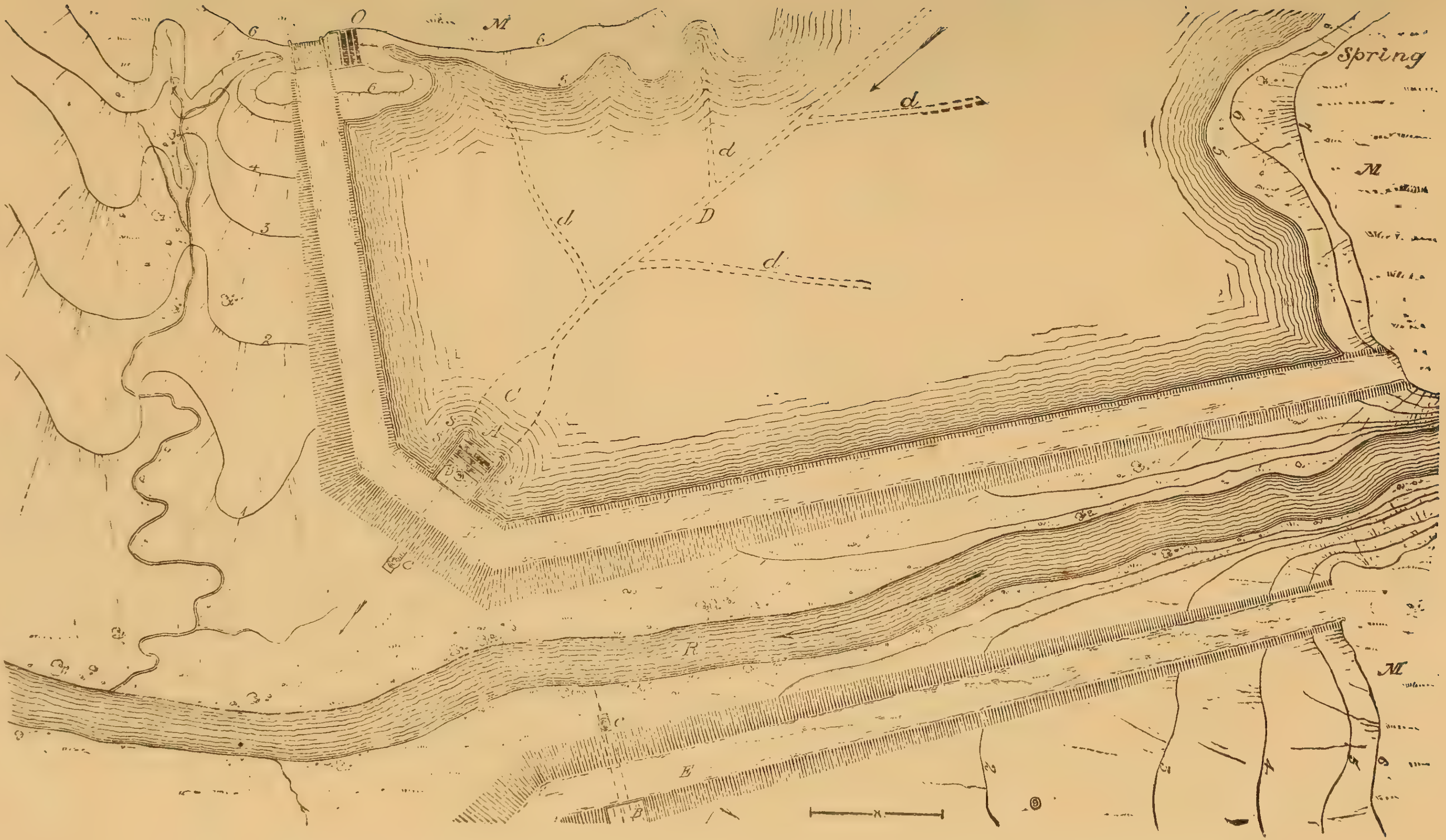
It is important in the first place that the ponds should have soft, muddy bottoms; and that they be furnished in the second place with aquatic plants—especially those producing seeds which will fall into the water when ripe. The Carp spawns in the spring and summer—often extending its breeding season into the fall months—and as the eggs upon being freed from the body of the fish attach themselves to the plants where they remain exposed to the attacks of other fish, by whom they are greedily devoured, no fish besides the Carp should be allowed in the ponds reserved for breeding purposes. The young fish, it should be remarked, usually make their appearance in from three or four to fourteen days, according to the temperature of the water.

CONSTRUCTION OF THE PONDS.

While it is certain that the cultivation of the Carp is of sufficient importance to the farmers to fully warrant the construction of ponds for the express purposes of such cultivation, it is also true that there already exist in many places—and more particularly in the southern and south-eastern portions of the State—numbers of ponds such as are now used for the collection of ice, or for supplying water to live stock during the summer could be readily converted into productive Carp ponds at a comparatively small cost. There are also many depressions of surface in the lands bordering upon some of our larger rivers, especially in the tidal region, which could be reclaimed and filled with water with but little labor, and made to answer admirably for the same purpose.

It is very desirable, on several accounts, that the ponds which are to be devoted to the cultivation of this fish should be so constructed as to permit all the water in them to be drawn off at certain intervals. By this means the fish can be readily captured and assorted without injury; when those intended for breeding purposes should be restored to the pond, and the remainder placed in tanks from which to be subsequently taken, by the aid of dip-nets or small seines, as required for market or for home consumption. The advantages of this facility of drawing off the water will be further experienced whenever the necessity arises for destroying such enemies of the fish as may succeed in effecting a lodgment in their midst.

In the case of such ponds as are supplied by the inflow of tide-water, for instance, the eggs of native fishes are often wafted in, and the fish thus produced soon commence to consume the food, and even the eggs and the young, of the Carp. By draining off the ponds once or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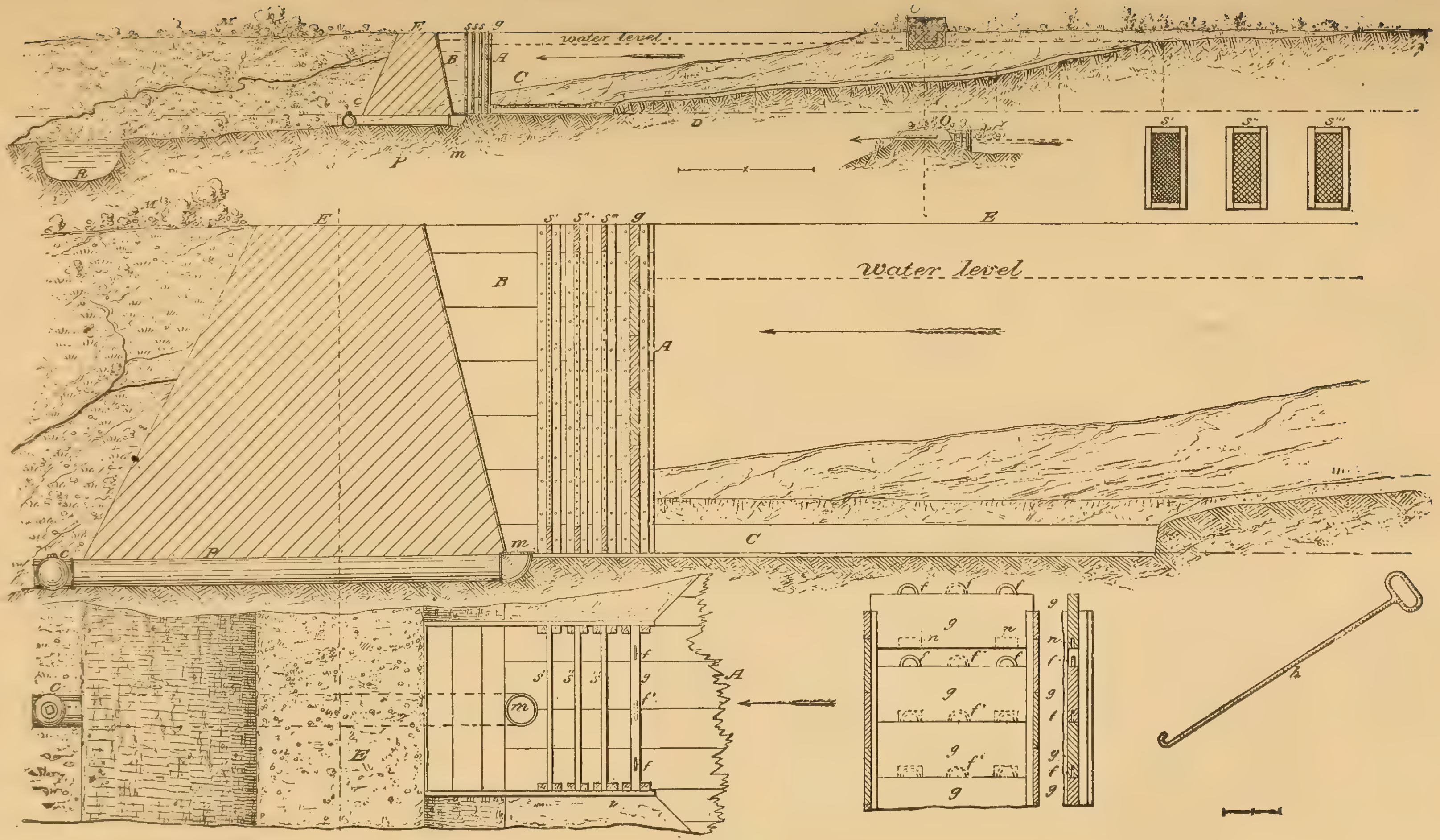
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twice a year however, these intruders can be readily removed and destroyed; and the fish which are the objects of the farmer's special care be allowed to exist and multiply unmolested.

When the utilization of an ordinary ice-pond for Carp culture is contemplated, the essential points to be regarded are so simple that it is only necessary to suggest them in order to the guidance of the most inexperienced culturist. In the preparation of ponds of this character it is not necessary that the drainage from the surrounding fields should be diverted, except when excessive in quantity or liable to become so after a heavy fall of rain. A certain amount of such drainage, indeed, often proves beneficial, as considerable quantities of food, generally of a very desirable nature, are thus conveyed into the ponds; in the event of its being admitted, however, an "overflow" must be provided, which should be well protected by wire-cloth screens to prevent the escape of the fish. As this overflow constitutes the most important feature to be regarded in the construction of a pond, it is necessary that it be first and carefully considered.

For the purposes of illustration, there are shown in the accompanying plates the details of a pond which is supposed to be located in a meadow, through which flows a rivulet or small stream; and formed upon two sides, by embankments of earth obtained by the removal of a portion of the soil from the enclosed space. The water may be supplied either by introducing it from the rivulet itself, at some higher point; or, as in this illustration, from a spring in the adjacent meadow, supplemented by the surface drainage from the surrounding high land.

A small tributary of the rivulet is utilized in this instance to carry off the surplus water which is allowed to escape from the pond through the overflow indicated at the point *O*.

A, shows the apparatus for emptying the pond; the details of which will be given in another connection.

B, indicates a frame, enclosing the end of the discharge pipe leading from the pond; and provided with screens, *s. s. s.*, the purpose of which will be indicated hereafter.

C, is the "collector," into which the fish are drawn by the lowering of the water in the pond; and *c* a valve, which controls the flow of the water through the discharge pipe, *m*.

D, indicates the position and direction of a wide, shallow drain at the bottom of the pond; having smaller drains, *d. d. d. d.*, by means of which all of the water is led into the collector when the pond is being emptied.

E, represents the embankments; which are about six feet in height at the angle of the pond, the lowest part of the meadow gradually lessening with the ascent of the land until they are lost in the higher ground.

In the next plate the upper portion presents a longitudinal section of the pond. The lower part of the plate shows a portion of the same section enlarged, so that with the horizontal projections the position and detail arrangements of the pond are clearly illustrated. The fish are readily drawn into the collector *C*. A long handle hook for removing the planks *g*, *g*. *g*, is shown at *h*.

As already stated, the "overflow," indicated at *O*, is perhaps the most important point to be considered, and especial attention is therefore directed to its construction. By way of precaution this outlet is located in the solid ground at the side of the pond, rather than in any part of the embankment, which might be weakened by its presence; and is protected by three wire-cloth screens of varying texture, the coarser mesh being placed farthest in the pond in order to collect all drift, and thus prevent the clogging of the second and third screens, the meshes of which should be fine enough to preclude the escape of the smallest fish. It will also be observed that the screens are so placed as to present a considerable surface below the water level—the purpose being to insure them against being clogged by the piling up of successive layers of drift, which otherwise would inevitably be occasioned by the gradual rise of the water consequent upon its obstructed flow. The arrangement suggested will always afford a free exit to the water beneath the mass of accumulated floating rubbish.

The general details of outlet, *A*, are clearly indicated in the views given. The screens *s. s. s.*—as well as those of the "overflow"—are disposed in a suitable frame work, and should slide easily in their respective grooves, so that they may be readily removed, cleaned and replaced. An additional set of such grooves are provided at this outlet, as will be seen by reference to the plate ; and these latter, which are innermost in point of position, are furnished, instead of screens, with solid planks *g. g. g.*—the edges of which are neatly fitted to each other, so as to render their joints water tight, or as nearly so as possible. The upper edge of each plank, again is provided with staples or eyes—*f. f. f.*—through which the hook, *h*, may be readily passed in order to lift the plank from the frame. When the planks are in position these eyes are received into corresponding slots, *n. n.*, in the lower edge of the planks immediately above them, so as to allow the planks to fit closely together.

The purpose of this fourth, and *solid*, screen is to enable the culturist to lower the water in the pond, whenever it becomes necessary to do so, by drawing it from either the surface or the bottom, as may be deemed most advisable. To draw it from the surface only, it will simply be necessary to open the valve *c ;* and to remove the planks in succession, as the water subsides. While to draw from the bottom will require all the planks to be first removed ; and the valve to be opened when this has been done.

In addition to the valve *c.*, the drain-pipe, *P*, may be provided, at *m.*, with a clog or strainer, to guard it against the accumulation of sediment or other obstructive matter.

The collector, *C*, as is shown in the plates, should be placed at the lowest point in the pond: and, unless excavated in very hard clay soil, should be both floored and faced with plank, cement or other hard material. The Carp, it will be remembered, have a strong tendency to bury themselves in the mud not only during their periods of semi-hibernation, but whenever suddenly alarmed or closely pursued: and if the collector has been constructed as suggested, and the fish are gradually drawn into it with the subsiding water, all danger of loss on this account will be obviated.

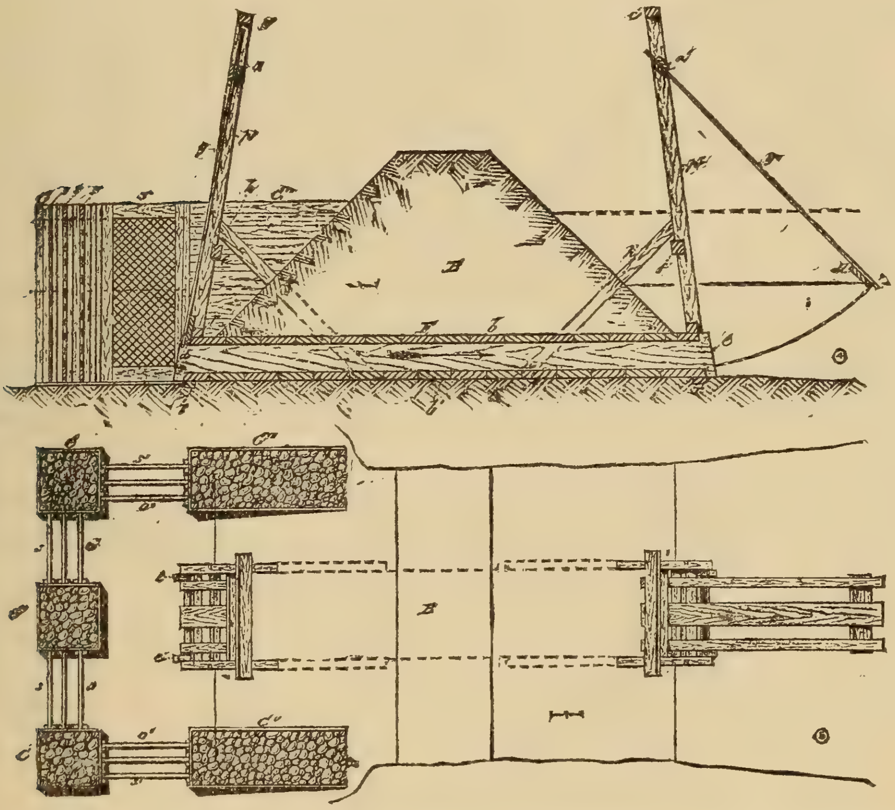
The details of the "overflow," "outlet," "collector," &c., may, of course, be somewhat varied, according to circumstances: but the general requirements of a pond so located as to receive its supply of water at one end, and to discharge it at the other, are believed to be fully answered in the foregoing description.

Ponds in this latitude should be not less than three feet in depth at their deepest part—to insure the fish against being frozen in severely cold weather—and should gradually shoal in places to a depth of one or two inches to provide the shallows required for spawning purposes. Small knolls and islands should be levelled or removed, as they generally afford harboring places for the enemies of fish.

PONDS IN TIDAL REGIONS.

It having been remarked in another connection that ponds formed by the reclamation of marshes in tidal regions might also prove well adapted to the cultivation of the Carp, the following suggestions are added with especial reference to the peculiar location of such ponds. The collector and drain ditches should be constructed and arranged in accordance with the instructions already given—the collector being formed, of course, at the lowest point within the embankment.

The "overflow" may be omitted, if desired, as the "flume" can be readily adapted to the purposes of carrying off any surplus water. As the flume, however, requires constant attention to insure its operation, the "overflow" should be retained, if practicable, in which event it is of even greater importance than in the case of the ponds already described that it should be placed in firm ground.



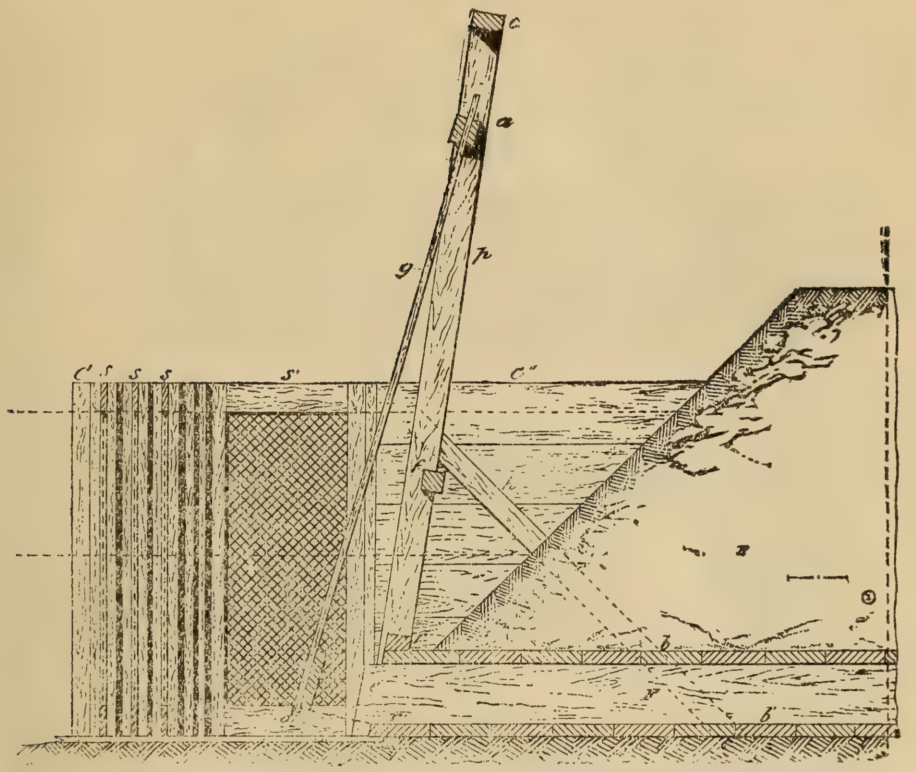
The accompanying diagrams represent a vertical section, and corresponding horizontal projection of the embankment, *B*—showing the position of the flume, *F*, and its controlling valves, *d*, *d;* together with that of the crib-work, "*C*, *C*, *C*," which is constructed on the pond side, and is designed to support the screens employed to prevent the escape of the Carp and the ingress of other fish.

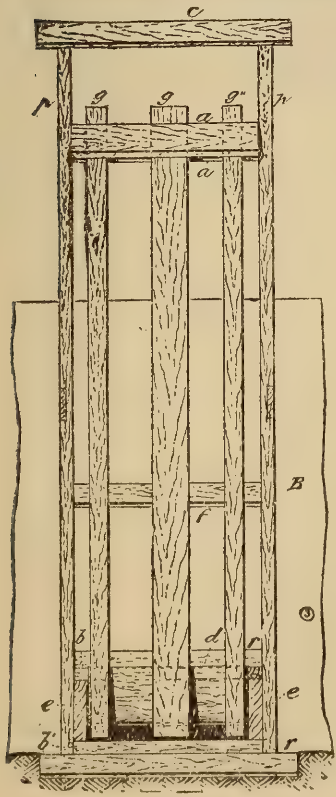
The flume is placed, as before, on a level with the bottom of the collector, and the valves are here shown as they appear when arranged for drawing the water *from* the pond, at ebb tide. The inner valve has been slightly raised, as will be observed, by *sliding* upward its support *g* through the grooved trunnion *a*; and the pressure of the water flowing through the flume, in the direction indicated by the arrow, serves to *swing* open the outer valve, and to keep it open until the pond is emptied or the tide turns. In the latter event the outer valve closes automatically until the level of the water without again falls below that of the water remaining in the pond when its operation is resumed.

Should it be desired, on the other hand, to admit water from the river *into* the pond—at the proper levels—the relative positions and operations of the valves would of course be reversed. The outer valve should then be raised so as to allow the water to enter the flume from the river; and the inner valve should be lowered, in turn, to permit it to swing with the current, and to close automatically with the cessation of its flow.

The accompanying figures represent portions of the above considerably enlarged for the purposes of a more detailed description of the several parts.

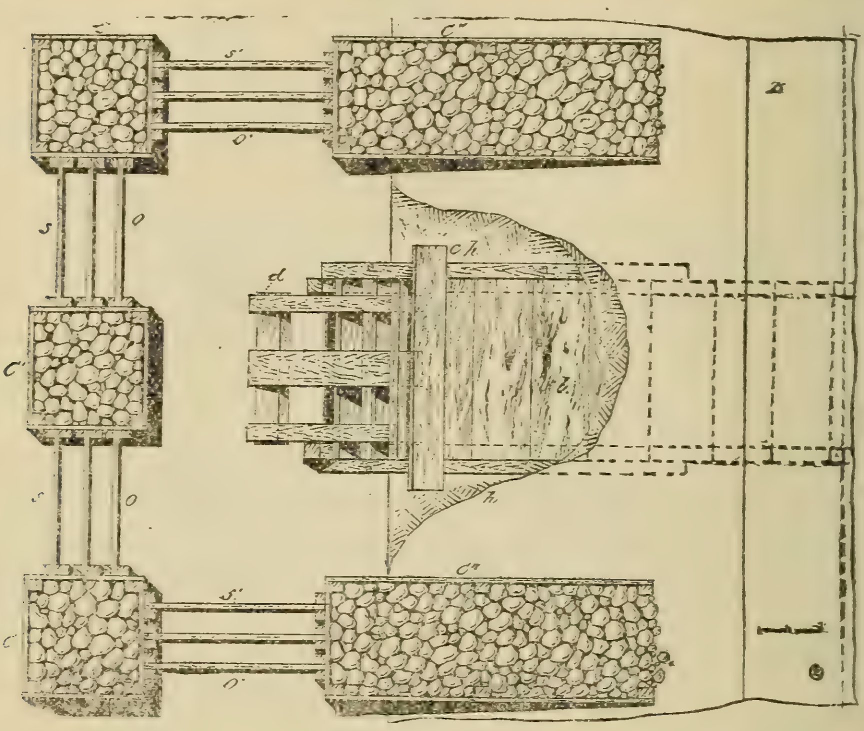
The flap valve *d*—which is here represented as being





forced slightly open by the presence of the inflowing current—is attached to the lower extremities of the long strips or pieces, *g g*, *g*, arranged to slide upward through mortices in the beam, *a*. The latter, in turn, is provided at each end with trunnions fitting loosely into corresponding sockets in the uprights *p*, *p*, by which means the beam and its dependent parts are allowed to swing readily in place, as indicated by the positions of the gate or valve in the several diagrams.

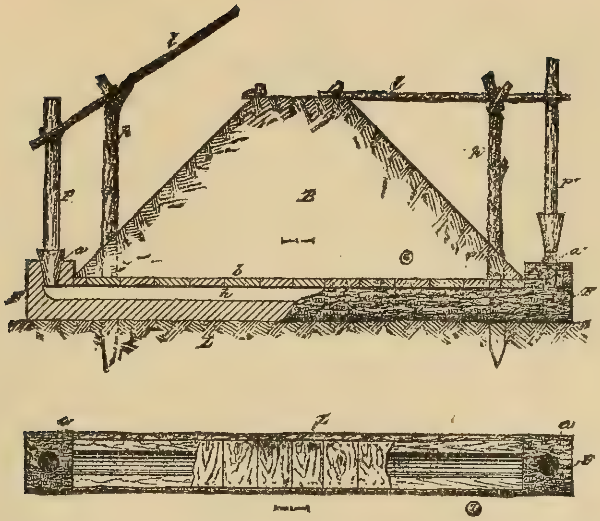
Another and fixed beam, indicated at *f*, serves as an additional support to the uprights, *p*, *p* ; and as the fulcrum of a lever by means of which the gate may be raised or lowered. "*C, C, C*" represent crib-work, filled with stones, and sustaining in position the screens *s*, *s* and *o*, *o*, which are arranged



to slide in their respective grooves, similarly to those already described.

A flume or trunk of somewhat simpler and cheaper design; which may be constructed by hollowing out one side of a stout log, for nearly its entire length, and covering the groove thus formed with pieces of thick plank, is also figured; the bark should be allowed to remain undisturbed, where practicable, for the sake of the protection which it affords to the wood. The general arrangement of the flume and its valves is so plainly indicated in the diagram as to render further description unnecessary; it will only be remarked, therefore, that as the valves do not work automatically, such a "plug-trunk"—as it is called—would appear to be better adapted for ponds located in other than tidal regions.

CIII



So much of the wood-work, in all these constructions, as may be exposed to the air, and, particularly, such parts as are subject to the alternate action of the air and water, are liable to more or less rapid decay, and should be protected by thick coatings of paint, or other preservative material. Such other parts as are imbedded in the embankment, however, will be found to last for years.

SUMMARY OF OPERATIONS at Hatching House, Druid Hill Park, for 1880.

MONTH.	Average temperature at noon of					CALIFORNIA SALMON.			LAND LOCK SALMON.			TROUT.			GERMAN CARP.						PENOBSCOT SALMON.	
		WATER.													*Scale.*		*Leather.*		*Mirror.*			
	Air.	Hydrant.	Troughs.	Springs.	Ponds.	Number eggs received.	Number fish or eggs lost.	Number distributed.	Number eggs received.	Number fish or eggs lost.	Number distributed.	Number eggs received.	Number fish or eggs lost.	Number distributed.	Number fish lost.	Number distributed.	Number fish lost.	Number distributed.	Number fish lost.	Number distributed.	Number fish or eggs lost.	Number distributed.
January	43.°78	41.°55	42.°58	52.°60	43.°03		217	8000	25000	573					6	870	*				1941	
February......	43. 58	41. 10	42. 10	50. 58	43. 44		85			1820		60000	4882	20000‡		100					573	
March	44. 46	44. 43	45. 23	51. 33	46. 55		32	1800		1051	200†	87000	19521	15000‡							1272	26000
April..........	56. 28	50. 46	51. 40	51. 13	56. 21		416			2932	10500	20000	19829	14300							385	32729
May	71. 72	60. 48	71. 06	54. 58	71. 93		3632			6401	6200		27358	39500	52	800						§
June..........	75. 76	70. 83	70. 56	59. 85	76. 99		153			83			1606	3200	2	30						
July	78. 88	76. 42	76. 36	61. 20	80. 41		28			20			1750		1	19						
August	76. 48	75. 16	74. 87	61. 00	77. 31					11			129	180								
September....	70. 87	71. 33	71. 33	60. 38	71. 15					11												
October	59. 17	61. 18	61. 22	60. 35	59. 93	200000	35916								635	200	60		47			
November ...	44. 28	47. 16	48. 27	55. 07	47. 83		7263	118000							216	5859	88	1710	95			
December	33. 20	37. 20	37. 50	50. 26	37. 48		528	38027							130	3680			9			
Total........	......	......	......	......	......	*200000	48270	165827	25000	12902	16900	167000	75075	57180	1042	11558	148	1710	151	....	4171‖	58729

*Excess over 200,000 caused by number lost and distributed from eggs received in 1879. †1 year old. ‡35,000 eggs.

‖From eggs received in 1879. §Pond No. 4 overflowed on 11th, causing a loss of between 2 and 3 thousand young Carp.

*200 Carp to S. G. Worth, N. C. 300 Carp to Washington, by Wm. Hamlen. N. B.—Not embodied in table of Carp Distribution.

OYSTER—(*Ostrea virginiana.*)

In my last report submitted to the Legislature on the 1st of January, 1880, I explained how the consideration of the oyster beds and the study of this important mollusk had been forced upon the Commission, as a thorough appreciation of the influences which bear upon the existence or non-existence, the increase or decrease of many of our important fishes, required some investigation as to the state of the oyster beds and the possibilities of employing means of continuing or restoring these beds, should they be destroyed by natural influences or by the too extravagant and wanton use of them.

Whereas the investigation was commenced rather to ascertain the capacities of the oyster-beds for producing food for the more important fishes, the developments have been so important and the prospects so bright of increasing by artificial means not only the number of oysters, but adding to their excellence by careful cultivation, I have prosecuted these researches to the fullest extent that the limited means at my disposal would permit.

It has been with much regret that the important experiments have of necessity been delayed and postponed from time to time, until by the practice of the closest economy in other branches of fish culture in the State a sufficient proportion of the portion of the appropriation assigned to me could be devoted to this purpose.

In consequence of the reduction of the amount available, the experiments have not been made on such a scale and with that thoroughness which I had hoped, nor have they been made as rapidly as their possible importance to the State would seem to demand. Enough has been determined to warrant the prediction that the day is not far distant when oyster culture on the Chesapeake Bay will be one of the most prominent industries of the State.

Besides indicating how the oyster industry can best be fostered and guiding capital in its best investment, I trust that the accurate knowledge obtained from these investigations may direct legislation on this hitherto very vexed and intricate question.

In our last report we gave at length the article of Prof. W. K. Brooks, whose services had been secured for these biological investigations by the Commission, and we, also through the courtesy of Mr. Carlisle P. Patterson, Superintendent of the Coast & Geodetic Survey, made copious extracts from the report of Master Francis Winslow, as to the physical conditions and surroundings of the oyster-beds in Pokomoke and Tangier Sounds.

The researches and discoveries of Dr. Brooks indicated the possibility of resuscitating this important though waning industry of the State; but, unfortunately, Dr. Brooks was prevented from carrying his experiments to such a length as to determine the best methods of taking advantage of the discovery of the possibilities of the artificial impregnation and production of the oyster.

The development of our oyster has been clearly marked and delineated in the report up to a state when it is a swimming animal and frequents the surface of the water. Unfortunately Dr. Brooks was not able to observe the continued development later than the sixth day, as the proper apparatus had not then been devised for the necessities of this service.

As this report contains some hints which may prove of much importance in the future, I take the liberty of again calling attention to them. Dr. Brooks says:

"All my attempts to get later stages than these failed, "through my inability to find any way to change the "water without losing the young oyster, and I am there"fore unable to describe the manner in which the swim"ming embryo becomes converted into the adult, but I "hope that this gap will be filled, either by future "observations of my own or by those of some other em"bryologist.

"In my attempt to raise the oyster embryo from the "egg, I found that continuous warm weather was essential to success. As my observations upon the developing eggs occupied all my time, I was not able to make any record of the temperature of the water of the ocean, but during June there were a number of cold, windy days and nights, and two hail-storms, and on each of the cold days all the embryo which I had in the house died.

"At first sight it does not seem possible that an animal which is encased in a hard, strong, protecting shell, and which is capable of giving rise to several million eggs every season, can be in any danger of extermination; and it seems as if the oyster ought to be able to hold its own in the struggle for existence, and to increase and multiply in the face of the most adverse circumstances.

"It appears wonderful that the waters of the Chesapeake Bay are not paved with oysters, and persons who have not given much thought to the subject will ridicule the statement that there is any need for measures to prevent their extermination or the destruction of the natural beds. While the consumption of oysters was restricted to regions in the immediate vicinity of the beds, the number of oysters which it would pay to gather and put into the market each season from each bed was limited; but with the present facilities for packing and transporting oysters, there is no limit to the number which can be utilized, and the danger of destroying the best beds grows greater every day, and keeps pace with the increasing population and improvements in transportation."

After giving some statistics of the catch of oysters in the Bay of Cancale, Dr. Brooks further remarks:

"The table also shows that it will not answer to rely upon the very great number of eggs, and therefore trust to a few oysters the work of replenishing the bed.

"In view of such facts, no one who appreciates the "magnitude of the oyster industry of the Chesapeake "can doubt that the protection of the natural oyster "beds is a matter which is worthy of the most careful "attention. While the manner in which this is to be "accomplished is outside the scope of the present paper, "a statement of those favorable and unfavorable influ-"ences which have suggested themselves to me during "my work, may fairly find a place here.

"It is well known to naturalists that the number of "individuals which reach maturity in any species of "animals or plants does not depend upon the number "which are born. The common tape-worm lays hun-"dreds of millions of eggs in a very short time, yet it is "comparatively rare. The number of children born to "each pair of human beings during their lifetime of from "fifty to eighty years, can be counted on the fingers, yet "man is the most abundant of the larger mammals, and "human population increases quite rapidly under favor-"able circumstances. This comparison shows plainly "that the abundance of a species is determined, mainly, "by the external conditions to which it is exposed, and "that the number of individuals which are born has "very little to do with it. In the case of the oyster, the "adult is well protected against enemies by the shell, "and as its food is abundant, and is brought to it by "the water, it is tolerably sure of a long life after it has "reached its adult form, but the life of the young is "very precarious; that of the young American oyster "peculiarly so, since it is exposed to all kinds of ene-"mies and accidents, at a time when it is most helpless. "The protection of the young European oyster by the "parent shell at this time would seem to more than bal-"ance the greater number of eggs laid by the American.

"The most critical time in the life of the American "oyster is undoubtedly the time when the egg is dis-"charged into the water to be fertilized, for the chance

" that each egg which floats out into the ocean to shift " for itself will immediately meet with a male cell is very " slight, and it is essestial that the egg should be fertil- " ized very quickly, for the unfertilized egg is destroyed " by the sea water in a very short time. The next period " of great danger is the short time during which the " embryos swarm to the surface of the water. They are " so perfectly defenceless, and so crowded together close " to the surface, that a small fish, swimming along with " open mouth, might easily swallow in a few mouthfulls " a number equal to the human population of Baltimore. " They are also exposed to sudden changes of tempera- " ture, and as my experiments have shown that a sudden " fall in temperature is fatal to them at this time, the " number which are destroyed by cold rains and winds " must be very great indeed.

" As soon as they are safely past this stage, and scatter " and swim at various depths, their danger from accidents " and enemies is greatly diminished, and their chance of " reaching maturity increases hundreds, and probably " thousands of times.

" My experiments show that there is no difficulty in " developing them up to this point in the house in small " aquaria, and in carrying them safely past the most " precarious part of their lives, and freeing them from " all their greatest dangers."

The importance of carrying the investigations beyond the point reached by Dr. Brooks, induced me to secure the services of Professor John A. Ryder, of the Philadelphia Academy of Sciences, and having provided quite an assortment of collectors, I stationed him in the month of July at the mouth of the south fork of St. Jerome's Creek, in St. Mary's County. This creek flows into the Chesapeake a few miles north of Point Lookout.

Having secured the use of ponds, formed by a prong of this creek, it was my intention to arrange them so as thoroughly to control the ebb and flow of the tide and the inflow of fresh water from the drainage of the land adjacent, by providing embankments, flood-gates, and waste-ways; but the unexpected diversion of a large portion of the appropriation prevented my carrying into effect these plans, so important for an exhaustive study of the subject.

In order to enable Prof. Ryder to carry on his experiments in a thorough and systematic manner, it was essential that a limited body of water should be isolated from the creek and the water be under complete control. It was important, also, that means should be provided that the enemies of the young oyster, as far as practicable, should be excluded.

Crude and imperfect as were the means available, Prof. Ryder pursued the line of investigations with important results, although he experienced the same difficulty in keeping the young oyster as did Dr. Brooks.

He was enabled during his stay at St. Jerome's to determine with some accuracy the rate of growth of the "spat" and to make very important researches as to the food and manner of fattening the oyster.

Prof. Ryder's report, which is full of interest, will be found in the appendix, and its careful perusal is earnestly recommended, as his cautious utterances should guide us to the future solution of this important question.

As soon as it can be done without detriment to the other important branches of fish culture, I trust that, with the additional light which has been shed upon this subject, I shall be able to provide Prof. Ryder with proper apparatus for the prosecution of these important investigations, for I am quite satisfied that as soon as we are able to artificially produce the oyster and protect the young until it finally attaches itself to some stationary object, we will have certain means of multiplying this bivalve to an unlimited extent and of furnishing it for planting purposes at less cost than can now be done by the dredging process. We will also be able with certainty to replenish beds which have been so far exhausted as to have lost, to a great extent, the power of reproduction in themselves, and to establish new beds in localities where the oyster does not now exist.

I trust that the experiments made and to be hereafter conducted, will enable us to determine the best form of collector to be used in our waters and the best manner in which it should be treated and the attached young oyster cared for.

The importance of the discoveries as to the means of artificial propagation of the oyster can be appreciated when we take into consideration the fact, that the soils and localities which are favorable for the reproduction of oysters are not always favorable for their subsequent development, as there are many places where oysters thrive but where they will not breed, it being generally accepted that the best conditions for propagation are sandy and gravelly bottoms and quite salt water, whereas muddy bottoms and a mixture of fresh water are most favorable for fattening.

The many conditions which influence the breeding, growth and development of the oyster—that is the soil, temperature, sudden alternation of heat and cold, direction of current, the occurrence of very low water at periods of extreme heat or extreme cold, and many other natural conditions, all indicate the importance of establishing now the artificial propagation of the oyster, notwithstanding its wonderful reproductive capabilities.

The importance of the oyster of the Chesapeake Bay can be appreciated by a perusal of the following figures, which I have obtained through the courtesy of Professor G. Brown Goode, Superintendent in charge of the fishery statistics of the census of 1880 :

OYSTER WORK IN MARYLAND 1879—80.

KIND OF BOAT EMPLOYED.	NUMBER.	VALUE OF BOAT AND EQUIPMENT.	NO. MEN EMPLOYED.	WAGES OF SAME.	NO. PEOPLE SUPPORTED BY OYSTER CATCH'G.
Dredgers	700	$1,050,000	5,600	$ 916,300	
outfit of same		70,000			
Scrapers	550	440,000	2,200	297,000	
Canoes	1,825	182,500	5,148	1,158,300	
Runners	200	300,000	800	166,400	
	3,275	$2,042,500	13,748	$2,538,000	54,992

NUMBER OF OYSTERS TAKEN 1879—80.	BUSHELS.
No. packed in State—of Md. oysters	6,653,492
" shipped out of State	2,021,840
Local consumption in Baltimore	818,680
" " other cities of the State	200,000
" " counties	875,000
	10,569,012

It will be seen that in the year 1879 to 1880, there were 13,748 of our citizens employed in catching and bringing to market the ten and a half million of bushels produced; and when we take this into consideration and the amount of capital consumed in preserving and exporting the oyster, the importance of providing for a continued supply is most evident.

The Chesapeake Bay, situated, as it is, between the colder waters of the north and the warmer southern zone, is unexceptionally suited for the cultivation of the oyster, its reproduction, growth and fattening, as it is not exposed to those vicissitudes of temperature which so frequently prove fatal; and the limited average in the rise and fall of the tide renders the existence of the oyster in shoal waters less precarious and their protection far less expensive than it has proved on the coast of France, where the oyster-growing industry has added new life and prosperity to portions of the coast which were fast becoming impoverished.

The facility for working the oyster parks at low tide in localities where there is a very great rise and fall of tide, is more than neutralized by the costly arrangements which must be devised for keeping them sufficiently covered to prevent their exposure to destruction, which would be the result were they laid bare at critical periods ; yet, although oyster culture has hardly existed a decade, the promises of success have been more than realized, and results have been obtained by the employment of methods so simple, that the proprietor of any oyster establishment will readily undertake to supply millions of oysters to any one wishing to enter upon their cultivation.

When we have ascertained with precision the period of attachment, when the spat forsakes its roving existence for a settled life, and have demonstrated that the oyster can be produced in unlimited numbers and successfully protected until this attachment is made, we will have gone far beyond those methods which have produced such good results in European countries, and it will be then necessary to take advantage of their experiences for the determination of the best form of collectors and the subsequent treatment of the oyster until it is sent in a perfect state to market.

It may, therefore, be more appropriate to reserve for a future report the details as to the form of collectors, information which I obtained during a recent examination of the typical oyster cultural farms of France. The determination of the form of collector best suited for the several localities of the Chesapeake Bay must be determined by actual experiment with the *chaplet*, (collector formed of shells strung on galvanized wire,) the favorite in the Bay of Arcachon ; the *bouquet*, (collector formed of twelve tiles secured around a stake which hold them in position,) a form much used in the neighborhood of Vanne and Auray; the *shingle*, *slate*, *brush*, *pottery* and other forms of collectors, severally the favorites in various localities.

Having advanced thus far in our experiments, it would be well for us to follow the methods of treatment and preparation of the oyster in practice at Courseulles, Les Sables D'Oleron and Marennes, where the energy of the culturalist is devoted to the fattening of the oyster for market.

The oyster industry forms too considerable a portion of the wealth of the Chesapeake Bay and is of too much commercial value to be allowed to suffer decline.

I trust that we may be enabled to prosecute our inquiries so as to present to the consideration of the Legislature the unanswerable logic of facts and suggest the methods of protection and devise means for continuing an ample supply of a great blessing which, although lavishly enjoyed, has scarcely been fully appreciated.

It is to be feared that much of the previous legislation has been ineffective, as based on evidence defective and misleading in its character, the result of misstatements and convictions formed by conflicting advice given by interested persons or by those misguided by too imperfect observation.

Respectfully submitted,

T. B. FERGUSON,

Commissioner.

APPENDIX A.

AN ACCOUNT

OF

Experiments in Oyster Culture

AND

OBSERVATIONS RELATING THERETO,

Made at St. Jerome's Creek, Md., during the Summer of 1880,

BY

JOHN A. RYDER.

INTRODUCTORY.

On the 18th of July last, Maj. T. B. Ferguson, Commissioner, having completed the preliminary arrangements looking forward to the establishment of an experimental station where every opportunity should be offered for the cultivation of the oyster by artificial means, employed the writer to carry on the necessary work of experiment and observation. The locality chosen for our operations by the Commissioner, was about seven miles north of the mouth of the Potomac River, on the western shore of the Chesapeake Bay, in St. Mary's Co., Md., and forms part of an inlet extending several miles inland, known as St. Jerome's Creek. Here, a pond, covering an area of perhaps two or three acres, which is joined to the main body of the creek by a narrow run or canal, through which the tide ebbs and flows, was chosen with the design of converting it into a *claire* or oyster park, somewhat similar to those in successful operation on the coast of France. The pond having been leased from the owner, Mr. J. W. Wrightson, for a term of years, with the privilege of making such improvements as might be necessary in carrying on the work of oyster culture, presents, in all respects, as favorable a situation in the opinion of the writer, for the purpose intended, as could be desired.

After some delay in getting our work agoing, we succeeded however, in obtaining some results and many experiences, which will be of great use in guiding us to the attainment of better results in the future. My object, in the main, was to learn what were the difficulties which would beset us in our future work and to find out what methods might suggest themselves as better calculated to further our efforts next season. The time of breeding was already nearly half over when our work began, and to this, as much as to anything, the comparative unsatisfactoriness of our results must be attributed. While we are forced to admit so much, a large amount of valuable information has been gathered, a good deal of which is entirely new to science and very suggestive as to what will be the proper paths to follow hereafter in the conduct of the work.

We have devoted a considerable amount of space to an account of the structure of the oyster, with illustrations, so as to make it easier for the anatomy and physiology of the animal to be understood by persons not familiar or within reach of the treatises on the subject. The idea has not been, to tacitly imply that the account given by Prof. Brooks in last year's report was not a good one, but simply to illustrate pictorially, as far as lay in my power, the grosser anatomy of the creature, so as to enable a novice to find the ovaries and spermaries of the animals more readily if it should be desired to impregnate the eggs artificially, either for the sake of experiment or artificial culture.

The numerous suggestions which have been made throughout the body of the text as to the extension of the banks and the possible practicability of entirely new plans of culture will, I hope, be found of value. The matters of mere scientific record and observation are such as would have been noted by any observer, endowed with a fair share of common sense and having a naturalist's training.

The appended observations on the artificial impregnation of the European oyster made by Francis Winslow, U. S. N., are important, as showing how closely parallel the phenomena of development in this species are to those of our own. I place entire confidence in these observations, as they are fully supported by what was previously known of their development through the researches of Davaine, Salensky and others, who, however, have failed to see the earliest stages.

The note on the development of *Mya arenaria* is added merely to establish the time of the spawning season; to show that it is possible to impregnate the eggs artificially, and to indicate to some extent the nature of the process of development, the study of which I could not complete owing to illness.

The histology of the ovaries of both the oyster and clam remains to be studied, since it is possible only by that means to ascertain whether the whole of the eggs are mature at one time. The researches of Flemming and Von Jhering show that such is not the case in *Unio* and *Scrobicularia.* Much of the success of future attempts at artificial incubation depends upon a decisive answer to this question. My own experience in investigating the ovaries of *Ostrea* and *Mya*, countenances the belief in my mind, that the time of maturity for nearly all the ovarian eggs is about the same.

The question as to the exact age of the fry of the oyster at the time of fixation, as well as the age of the fry of *Mya* at the time it buries itself in the sand, also awaits an answer; but it is the hope of the writer that, with an incubating apparatus which he has lately devised as an adjunct to his microscope, he may in the course of another season's work, reach a satisfactory conclusion in regard to this, as well as many other important matters.

ANATOMY OF THE OYSTER.

THE SHELL.

In view of the fact that the structure of the American oyster has hitherto excited comparatively little attention, we offer here the results of investigations made upon thirty-seven specimens. The best account which is known to me, and one accompanied with a good figure, is that given by H. James Clark*, and which anticipates in many respects, a note contributed by the writer to the *American Naturalist* for September, 1880. Another admirable account of the structure of this mollusc has been given by Prof. W. K. Brooks†, but after comparison, I find that my observations are not wholly in accord with the accounts of either of these careful observers.

In Fig. I, I have attempted to represent in a somewhat diagrammatic manner the structure of the animal under consideration, with indications of some of its physiological or animal processes, such as the inhalation and exhalation of water for breathing purposes, and the manner in which the food is carried to the mouth to be swallowed.

The oyster always presents a definite right and left side, and the two shells or valves which enclose the animal, always differ in that the left one is more deeply concave or hollowed out than the right, which is nearly flat. In the natural beds the left valve is usually, if not always undermost, but in the crowded banks the animal usually assumes a vertical position, a condition which does not, however, affect this unlikeness of the valves. In the figure, the left valve has been removed, the animal of the oyster is shown lying in the more shallow right. The head end of the animal lies close against the

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*Mind in Nature. New York, 1865. pp. 199—203.
†Report of the Maryland Commissioners of Fisheries, 1880. pp. 5—10.

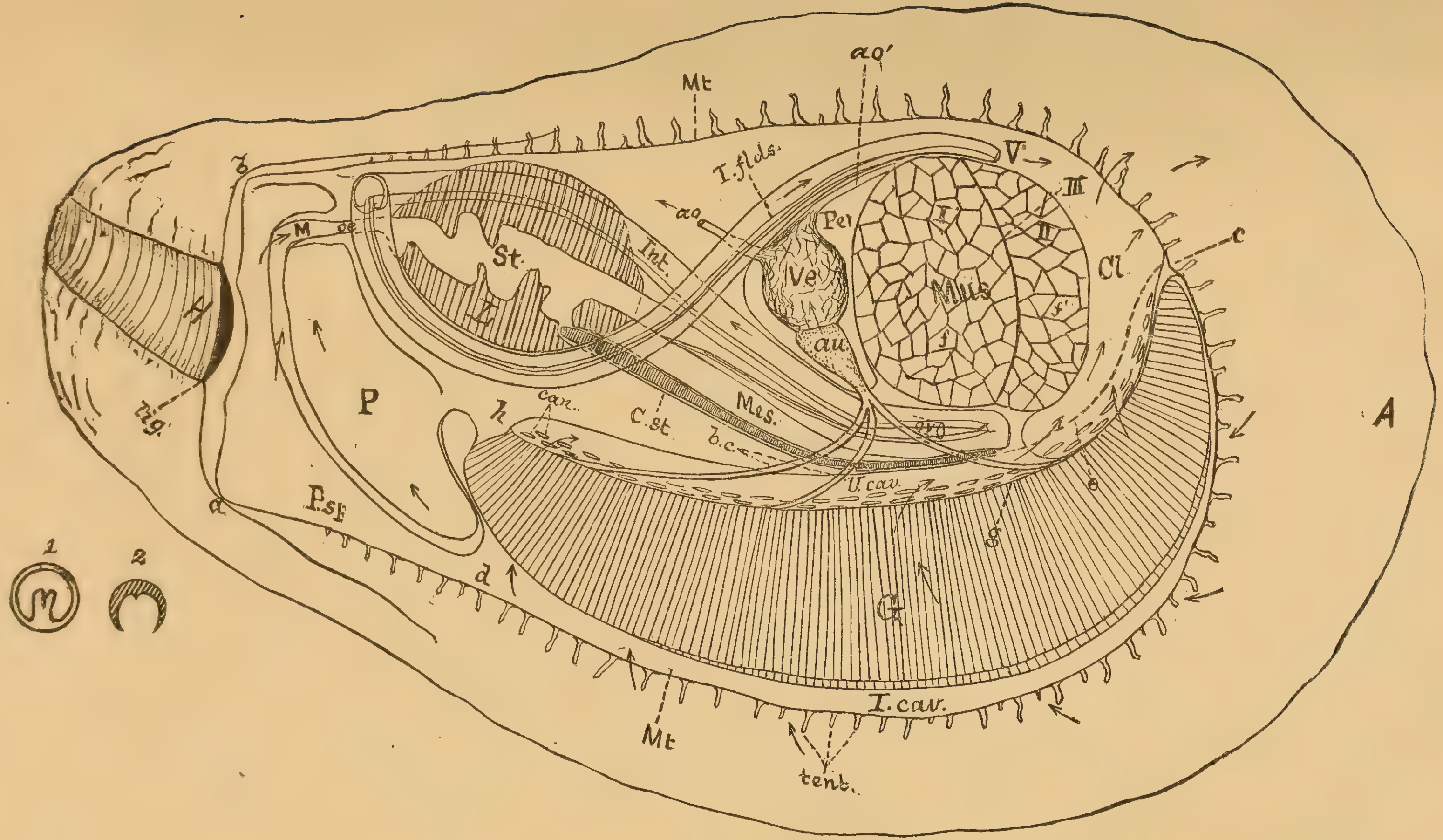
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Figure I.

hinge *H*, or the point where the two valves are firmly fixed to each other by a dark brown crescent-shaped body, the ligament *lig.*, which, while it serves to attach, also tends by reason of its elastic properties to cause the valves to separate at their free borders at *A*, in order to allow the passage of water inwards to the gills *G*, and of food to the mouth *M*, while it also allows the water which has passed through the gills to escape by way of the cloaca *Cl*, carrying with it in its passage the faeces from the vent *V*. The tendency to separate the valves, inherent in the ligament, is balanced by the adductor muscle *Mus*, which, upon the slightest intimation of danger, forcibly contracts, closing the free edges of the valves tightly. The dark purple scars near the centres of both valves, and vulgarly known as indicating the position of the "heart," are simply the areas covered by the attachment of this adductor muscle, which is composed of a vast number of extremely fine muscular fibers, which collectively pass straight across the space between the inside of the valves, being firmly fixed at either end to the latter. The muscle, when closely examined, is seen to be composed of bundles of fibers or fibrillæ, which may be called fibrils, each with its proper sheath, and polygonal in cross-section. The muscle is also made up of two kinds of fibers, the larger portion, embraced in the area I, are brownish gray, while those in the smaller area II are whitish ; the line of contact between the two is sharply defined by the curved line III, where they are also easily separated as portions of a compound muscle. The foregoing fairly describes the mechanism of the shell, and in part the physiological significance of the same.

The structure of the shell is laminar, or in other words, it is composed of numerous layers of carbonate of lime deposited one on the other by the mantle (the latter to be described farther on,) probably from the blood or possibly in some other way. These layers deposited as they are internally, as growth proceeds project in succession past each other at the free edges of the valves and external surface of the shell, so that the successive deposits may frequently be distinguished, espepecially, as these deposits seem to be laid down periodically, giving rise to a very rough imbricated appearance of the edges of the layers on the outside of the shell. The inner pearly or nacreous layers of the shell are different in structure from the outer ones. These are made up of microscopic prisms of carbonate of lime embedded in a matrix of horny substance, analogous, if not identical with the substance which forms the external hard parts of insects The outer portion of the shell, forming much the largest proportion of the whole, is differently constituted according to Nathusius-Königsborn*, who finds that in the shells of the oyster of Europe there are superimposed cavities, filled in life with water, which lie just beneath the inner pearly layers and between the attachment of the muscle and the hinge corresponding to the thickened nacreous portion. In the thick marginal portion of the shell, extending from a point half way between the insertion of the muscle and hinge, to near the edge of the valves, he finds still another series of closed cavities which are separated by oblique divisions of a laminar character, and which are filled with a singular structure of minute cavities which contain air. The first kind or the water bearing cavities are, it may be well to remark, greatly developed in *Spondylus*, an ally of the oyster. The laminar character of the shell is apparent from the presence of very fine lines of growth even on the valves of the free-swimming embryos, and in the embryonic shell which covers like a little raised cap the extreme tips of the umbos or hinge ends of the valves of attached spat ¼ to 1 inch in diameter.

During the past season I endeavored to ascertain if it was not possible to determine the age of marketable oysters from what appeared to be annual arrests of growth, indicated on the outside of the shell by deeply impressed lines or projecting laminae placed at nearly equal distances apart, but I failed, after examining a great number of living and dead shells, to arrive at any satistactory conclusion.

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*Untersuchungen ueber nicht celluläre Organismen, namentlich; Crustaceen-panzer, Mollusken—Schalen und Eihüllen.— Von W. Von Nathusius-Königsborn. 4 to., pp. 144, pls. 16. Berlin, 1877.

THE ANIMAL.

In Fig. I the head of the animal lies directed towards *H;* the tail end, on the other hand, lies towards *A;* the back or upper side of the animal extends from *b* to *c;* the ventral or lower side reaches from *c* to *a* up to the mouth *M.* The right and left sides of the animal are covered by an organ called the mantle *Mt. Mt.;* it is not attached to the shell anywhere except around the points where the ends of the adductor muscle, *Mus*, are fixed to the valves of either side. This organ encloses, like a curtain, the internal organs of the creature on either side, and lies next to the shell, and secretes and deposits the layers of carbonate of lime composing the latter. The free edges of the mantle, which are purplish, are garnished with small, highly sensitive tentacles *tent.* of the same color, and which serve the purpose of organs of touch and are perhaps also to some extent sensitive to light. The borders of the right and left folds of the mantle are free from *b* to *c*, where they unite, and from *c* to *a*, but from *a* to *b* they are joined together. In the space between the right and left folds of the mantle from *b*, *a* to *d*, the palps *P*, or lips of the oyster, are included; this cavity may be called the palpal space *P. sp.* The palpal space is continuous with the inferior gill cavity *I. cav.*, from *d* to *c;* in this space, bounded like the latter on each side by the mantle, the four leaf-like branchiae or gills *G* hang suspended by a membrane, which unites with the mantle on either side along the line *e;* this membrane, together with the bases of the gills, forms a cavity limited below by the upper edges of the gills at *g* and above by the viscera along the line below *C. st.*, the mesosoma *mes.* or lower middle portion of the body and the adductor muscle; this upper gill cavity *U cav.*, extends from *h* to *c* and is continuous with the cloaca *Cl*, which is the space between the upper free folds of the mantle from *b* to *c*.

The physiological significance of this arrangement of parts will be understood by noting the directions in which the arrows are supposed to be moving. As the living oyster lies fixed at the bottom of the water with the free edges *A* of the valves slightly separated, the minute cilia or hair-like processes with which the gills and palps are covered, are constantly in rapid vibratory motion; this peculiar movement over the gills and palps causes a current of water to travel from without into the inferior gill civity *I. cav.*, a part of which passes on to be carried by the cilia of the palps towards the mouth for the sake of the microscopic food it may contain in suspension; after this has been gleaned out, the water probably passes back to the inferior gill-cavity between the pendulous lobes of the outer and inner pairs of palps. The fate of the water which passes through the gills is entirely different, though the gills seem to take part in carrying food towards the palps and mouth, a phenomenon which may be readily rendered apparent to the eye by scattering powdered cochineal or fine meal on the gills or palps, when it will be seen that the motion of the cilia on both organs causes the particles to move with considerable rapidity towards the mouth. The water passes up between the leaves of the gills, actuated by ciliary motion, and enters the upper gill cavity through a large number of openings or canals between the gills *can.* and passes out towards the cloaca *Cl*, into which the vent *V* also discharges its excreta, and is so carried out of the animal back into the surrounding water. The whole of the process of respiration or aeration of the blood appears to be effected in the gills proper.

The transversely elongated mouth *M.* of the oyster lies between the upper bends of the palps, it is followed by a very short gullet or oesophagus *oe*, which opens into tne stomach *St*, the walls of which are very much folded and wrinkled, the folds often dip into the substance of the massive brownish green liver *L.* and give entrance to the numerous and spacious bile ducts of the latter. At the hinder end of the stomach one of the deep folds appears to be continued backwards in the form of a blind, cylindrical pouch to or beyond and between the openings of the oviducts of either side; this pouch contains a transparent, but at the same time opalescent rod, the so-called crystalline style *C st*, the function of which is not known. The intestine as it first leaves the stomach proper is somewhat wider than at other points, but I do not know why Prof. H. J. Clark considered this portion, as far back as the first bend, part of the stomach. It seems to me that the irregular digestive cavity enclosed in the liver-mass should be regarded as the stomach, because the first portion of the intestine already contains the commencement of a peculiar pair of folds running lengthwise, which will be spoken of later. Returning to the course of the intestine *Int*, after passing backwards beneath the adductor muscle, into the mesosomal or middle part of the body, when it suddenly bends and is prolonged toward the head, passing a little to the right of the stomach and along the back of the animal, when it again suddenly turns to the left and crossing the gullet *oe*, descends in a gentle curve along the left, lower side of the body, passing obliquely upwards over the pericardial space *Per*, which contains the heart, to end in the anal opening at *V.* A peculiar double fold, *I. flds*, which projects into the intestinal cavity, extends from the pyloric end of the intestine to the vent; its function is probably to afford a greater amount of surface for the absorption of nutriment, or it may be valvular in character. The greater portion of the inner intestinal surfaces are probably covered with cilia in more or less active motion, for all the portions of the lining of the stomach and intestine examined by me appeared to be provided with a ciliary covering. The faeces of the oyster are not extruded in the form of a cylinder as in many other mollusks, but have the form of a demicylinder with one side excavated in a groove-like manner, as shown in section in Fig. I, 2, the peculiar form being due to the presence of the longitudinal folds in the intestine, as shown in a cross-section of the latter in Fig. I, 1. In *Unio*, the fresh-water mussel, a similar arrangement is said to exist, according to Bronn ; (Klass. u. Ord. des Theirreichs, III, p. 364.)

The course of the intestine as sketched above is most nearly in accord with Clark's account ; the figures given by Sir Everard Home* of the intestine of *Ostrea edulis* are also in close agreement, but the proper relation of the mouth and palps was evidently not understood. Home's figure, however, fully justifies, with other evidence, the criticism made in Woodward's Manual of the Mollusca, regarding the inaccuracy of Poli's† figures of the same parts.

The systemic heart is that organ which serves to propel and continually redistribute the colorless blood of the oyster through the body for its nourishment, and through the gills that the blood itself may discharge into the water the poisonous gases with which it is loaded in passing through the body, and receive a fresh supply of oxygen as fresh supplies of water pass through the gills. The heart consists of three chambers ; the upper and largest is the ventricle *ve*, and the two smaller, lowermost, brownish, paired chambers are called auricles *au ;* the three chambers lie in a crescent-shaped space, the pericardial space *Per*, just forward of the adductor muscle. The ventricle *ve*, is almost globular;

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*Philos. Trans. 1827. pl. IV.

†Testacea Utriusque Siciliae eorumque Historia et Anatome, II. Tab. XXIX, fig. 3. Parma, 1795, Fol.

its walls are made up of a delicate meshwork of muscular fibers so interlaced as to be altogether untraceable; by its contractions it forces the oxygenated blood fresh from the gills to all parts of the body through two large vessels, or properly, aortae, the first, *ao*, supplying the forepart of the body, and *ao'* the hinder portion. These larger vessels divide into smaller ones which effect the distribution of the blood towards the head, and through the viscera, where, as in other parts of the body, a network of fine capillary vessels exists. The blood accumulates perhaps in sinuses, one of which is the pericardial space, and there are besides probably a pair of rudimentary ones in the oyster, the vestibule of a rudimentary organ of Bojanus, from these, through the venous system of vessels, the blood is carried back to the gills to be aerated, and returned through the vessels which carry the blood from the gills to the auricles, the branchio-cardiac vessels *bc*. Of the last, there are three on each side of the oyster, two pairs of which collect the blood from the forepart of the gills, and one pair of which gather the blood from the posteriar portion of the gills to be carried to the auricles, from whence it enters the ventricle, having completed its circulation through the whole vascular system.

It is frequently noticed that the edges or a considerable part of the mantle of the oyster is very much swollen and nearly transparent, as though greatly distended with water; this is due to a peculiar arrangement of capillary vessels connected with the blood-system which causes the blood to be held in these places until turgescence is produced as in erectile tissues. The presence of an unusual amount of water in the blood no doubt sometimes helps to produce this last effect, since the blood-system is probably in communication with the water outside, through the openings from without into the organ of Bojanus, a part which answers to the kidney in other bivalve mollusks, but which seems to be very rudimentary in the oyster. When oysters are removed from salt water to that which is less salt, a similar enlargement of the animal takes place, which may be entirely attributed to the effect of the action of the well-known laws of osmosis, and should not be regarded as a fattening process at all, since the real "fat" of the oyster is something vastly more substantial than water, as will be learned in the sequel. Prof. P. Frazer, Jr.,* has discussed the subject of fattening oysters by means of osmosis.

For my own part I believe that the turgid, translucent appearance of the edges of the mantle in the oyster is due to the passage inwards of water through the mouths of numerous vessels which open freely on its surface; these from my microscopic examinations seemed to be the extremities of the capillaries of the mantle, and I find that for this belief I have the concurrent testimony of other writers, (Bronn; Klass. u. Ord. III, 384.)

The nervous system of the oyster is very simple, being composed of a pair of ganglia or masses of nervous matter, which lie just over the gullet, and from which a pair of nerve cords pass backwards, one on each side, to join the hinder pair which lie just beneath the adductor muscle. The mantle receives nerve branches from the hindmost ganglia, and these control the contraction and elongation of the radiating bundles of muscular fibers as well as those which lie lengthwise along the margin; the former contract and withdraw the edges of the mantle from the margin of the shell, while the latter in contracting tend to crimp or fold its edges. The tentacles, or organs of touch, are also mainly supplied from the hindmost ganglia, while the internal organs are innervated from the head ganglia.

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*On Dialysis in Oyster Culture. Proc. Acad. Nat. Sciences, 27. 1875, pp. 442—43.

The generative organs of the oyster, *Gen.* Fig. 2, are massive in proportion to the size of the animal; they invest the whole of the visceral mass from a little behind the palps to the pericardial space, extending beyond it posteriorly above and below. They invest the rectum to within a short distance of the vent and the first bend of the intestine below the adductor muscle; their substance also dips down deep amongst the viscera so as to appear to cover the intestines, the pouch of the crystalline style and the liver. The sexes of the oyster are distinct, but

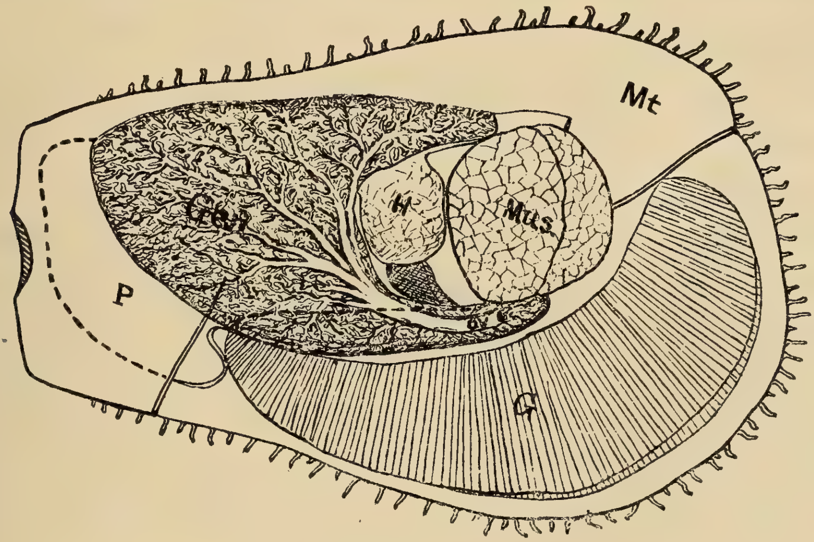

Figure 2.

there is no apparent possibility of determining the sexes from the external appearance of the generative tissues, since there seem to be no differences between what in one case are ovaries containing eggs, and in another spermaries or testes, containing the male cells or spermatozoa. Both kinds of glands are composed of a great number of tubular branches which unite into two large canals, one on each side of the body, which open into thr upper gill cavity at *ov;* the oviducts if the specimen be female, and *vasa deferentia* if the specimen be a male. The smaller branches divide and subdivide, as may be noted in Fig. 2, giving off ultimately short blind, pouch-like branches, which are the follicles of the glands or acini, on the inner walls of which the ova or eggs and spermatozoa are developed. The eggs in the female grow from ovicells, and in the male the spermatozoa originate from cells which are known as spermogens.

In having a pair of openings, one on either side for the escape of the generative products, our oyster agrees perfectly with that of Europe, according to H. Lacaze-Duthiers.* Davaine,† in his memoir, asserts both in his text and in his figures that the generative glands of the European oyster have three openings on either side, statements which are not in accord either with facts or analogy. In a paper by Sir Everard Home, which we have noticed before, he erroneously regards the suprabranchial or upper gill cavity as an oviduct.

No evidence to show that our oyster is hermaphrodite was found during the entire season, nor were my searches for embryos or eggs on the mantle and in the gills any more successful than those carried on two years before by Prof. Brooks. There is no doubt whatever that the oyster of Europe nurses its young on its mantle and gills for some time, nor can we very well question the very high authority of Möbius for saying that in most cases the sexes are separate, and that but one kind of products, viz.; either eggs or spermatozoa are at any one time found in the generative organs; Lacaze-Duthiers' observations seem to confirm the conclusions of Möbius.

As the eggs and spermatozoa ripen and are set set free in the little terminal sacs or acini of the generative organs, they are probably pushed or driven out of the larger canals which connect with the terminal sacs, and which join the main oviduct *ov*, by means of cilia which line these canals, as suggested by Lacaze-Duthiers, just as the food is carried to the mouth and the water continually forced through the gills by the waving of the innumerable cilia which cover the latter and the palps. The oviducts open directly into the upper gill cavity, from whence the eggs or sperm which have been discharged thereinto are at once carried out into the water immediately surrounding the animal in the open sea. From the fact that the eggs are heavier than water, although each female oyster matures many millions, it is easy to understand why it is that but comparatively few, probably only a fraction of one per centum of all that are laid, ever develope or fix themselves even under favorable circumstances, since much the largest portion of them are never impregnated, while of those which are, but few ever find positions favorable to their growth under natural conditions.

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*Recherches sur les Organes genitaux des Acephales Lamellibranches. Ann des Sci. Naturelles. 4 ser, zool., t. 2, pl. 8, pp. 214—228. Paris, 1855.

†Mem. de la Soc. de Biol. IV, 1852, pp. 297—339, pls. I—II.

HOW AN OYSTER TAKES ON FLESH.

Amongst oystermen the business of "fattening" or feeding the oyster is one of the most important from the fact that upon the condition of the marketable product largely depends its value. Fatness in the oyster is a condition wholly different in nature from the state known under that name in stall-fed domestic animals; nor has it anything to do with the condition of the reproductive organ, as Prof. Brooks* seems to suppose, for oysters are mainly taken from their beds at a season when that organ is in an inactive condition and appears shrunken and wasted away, as it truly is. The word "fat" as applied to indicate the condition of the oyster when in flesh, is a misnomer, since it is not fat at all which is the immediate cause of the condition of plumpness, which betokens a fitness for market, but a very extensive deposit of protoplasmic material which has been mainly laid down in the substance of the mantle. It is not denied that there are oil globules to be found in this deposit, but it *is* denied that the term "fat" applies as descriptive of it. It is this relatively large amount of delicate, easily digested protoplasm of the mantle which renders the oyster so wholesome and nutritious.

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*Development of the American Oyster, p. 10.

N. B. Möbius seems to have clearly apprehended the true nature of the so-called fattening process.

The deposit of this protoplasmic material in the mantle, palps and body, stands in intimate relation to the activity of the reproductive organs. During the spawning season oysters are said to be "poor," that is, poor in condition, for at this time the mantle, especially where it lies next the body on each side, is very thin and quite transparent; the radiating muscles at the edges as well as its vessels and nerves may now be readily studied under the microscope, owing to the transparency and absence of soft granular protoplasm. If we examine at this time the reproductive organs, as a rule, we will find them greatly developed and pouring out their products through two large ducts, the combined caliber of which is not far short of that of the intestine. It will be evident to any thinking mind that if the major part of the food material elaborated by the stomach and intestine goes to the ovary or testes to be transformed into sex products, which are continually thrown off, little of such material can be stored up in the tissues of the body.—This is exactly what happens. In the month of September when the oysters for the most part stop spawning, the drain of elaborated material having ceased to flow from the openings of the reproductive organs, it is diverted in another direction, but is retained in the system, and has to be deposited somewhere in the body. The most extensive deposits of this elaborated living matter occur in the mantle, body and palps, the color of which rapidly changes from the watery transparent condition prevalent during the spawning season to a creamy white. The mantle and palps now become very much thicker than before, and their substance appears to be softer, more easily lacerated, and is made up largely of a delicate granular protoplasm, which when broken up has the milky appearance of the reproductive organ when it is mutilated. I have known this milky appearance of the mutilated mantle of the oyster to lead persons to mistake it for the reproductive organ; a mistake easily made by the inexperienced.

The preceding account of the physiology of the so-called fattening process will serve to prove how little philosophy there is in the doctrine that oysters may be fattened by putting them for a day or two in water less salt than that from which they were first taken, in order that they may be water-swollen by the action of osmose so as to give them a plump appearance.

Upon making an examination of some oysters to-day (Dec. 6th,) to learn something in regard to the nature of the so-called fatty material contained in the thickened mantle, I find that it is made up of nucleated cells composed of a fine corpuscular material. The protoplasmic granules are so fine that they remind one, when examined under a power of 250 diameters, of the corpuscles found in milk, though they are probably quite different in nature. They manifest the dancing motion when highly magnified, which is known as pedesis or the Brownian movement, and appear to be perfectly spherical with considerable variation in size. Upon examining another specimen I found the principal ducts of the testes already defined, and upon microscopic examination an abundance of active, though not perfectly mature, spermatozoa were noticed. The spermaries in this case may no doubt be considered as a part of the fat, but the case is most interesting as showing how very early in the season the generative products commence to develop.

FOOD OF THE OYSTER.

The food of this mollusk, as is well known, consists entirely of microscopic beings and fragments of organic matter, which are carried by currents from the palps and gills, which have been already described, to the large mouth of the animal at the hinge end of the shell. The inside of the gullet and stomach, like some other parts of the body, are covered with cilia, so that food once fairly in the mouth will be carried by their action down to the cavity of the stomach, where it is carried into the folds and deep pouches in its walls and even into the openings of the bile ducts, to undergo digestion or solution, so as to be fitted in its passage through the intestine, to be taken into the circulation, and finally disposed of in building up the structures of the body.

Along with the food which is taken, a very large amount of undigestible dirt or inorganic matter is carried in, which in a great measure fills up the intestine together with the refuse or waste from the body. This material, when examined, reveals the fact that the oyster subsists largely on diatoms, a low type of moving plants which swim about in the water encased in minute sandstone cases or boxes of the most delicate beauty of workmanship. These, when found in the intestine, have usually had their living contents dissolved out by the action of the digestive juices of the stomach. I have found in our own species of oyster the shells of three different genera of diatoms, viz. : *Campylodiscus*, *Coscinodiscus* and *Navicula.* The first is a singularly bent form ; the second is discoidal, and the last boat-shaped, and all are beautifully marked. Of these three types, I saw a number of species, especially of the latter, but as I was not an authority upon the systematic history of any of them, I had to neglect the determination of the species. No doubt many more forms are taken as food by the oyster, since I saw other forms in which the living matter inside the silicious cases was brown, the same as in most of the preceding forms, which I have indicated. Some of these brown forms were so plentiful as to color a considerable surface whereon they grew, of the same tint as themselves. But in no instance have I found any indications of the animal of the oyster becoming colored by feeding on these diatoms, as it is said the European oyster does when feeding on *Navicula ostrearia*, which is green, imparting its own green color to the fluids and thus to the tissues of such oysters as may be so situated as to readily feed upon it. A recent writer* gives an account of some experiments made by M. Puysegur of Sissable in artificially producing this green color, from which I quote : "In each plate, [filled with water charged "with green diatoms,] according to its size, we put three "to six perfectly white oysters which had never been in "the 'clears' and the shells of which had been previously "washed and brushed clean. In similar plates like num-"bers of the same oysters were laid in ordinary sea-"water. Twenty-six hours after the commencement of "the experiment the oysters in the water charged with "diatoms had all acquired a marked greenish hue ; the "other oysters remained unaltered. * * * * "After the oyster had turned green, it was laid in ordi-"nary sea-water for a few days, when the greenness dis-"appeared altogether. It reappeared when the oyster "was replaced in fresh water containing *Navicula ostre-"aria*." M. Decaisne, of the *Jardin des Plantes*, Paris, repeated the experiments with the same results.

Besides the diatoms, the spores of algae, the larvae or young of many animals, such as Sponges, Bryozoa, Hydroids, Worms, Mollusks, many of which are small enough to be taken in by the oyster, though their bodies in most cases being soft and without a skeleton, it is impossible to find any traces, either in the stomach or intestine, of their remains, to indicate that they have formed a part of the bill of fare of the animal. What, however, demonstrates that such small larval organisms do help to feed the oyster, is the fact that, at the heads of the small inlets or creeks along the Chesapeake, where the water is but little affected by the tides and is somewhat brackish and inclined to be stagnant, there always appears to be a relatively greater development of a some-

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*The green color of Oysters, H. M. C. In *Nature*, Vol XXII, 549—50, 1880. Trans. from the Revue Maritime et Coloniale, February, 1880.

what characteristic surface or shallow water fauna of minute forms.

In St. Jerome's Creek the microscopic fauna of its head waters is entirely different from that of the body of the creek ; two minute forms inhabit in vast numbers the former, while I sought in vain for them in the more open and changeable waters of the main body of the inlet, which are brought into active movement twice a day by the action of the tides. One of these forms an Infusorian*, 1-25th of an inch in length, was found covering every available surface of attachment, so that countless multitudes of the naked young would be swimming about in the water previous to building the curious spiral tubes which they inhabit; admirably fitted in this state as food for the oyster. Beside the type referred to there were a number of other Infusorians which in their so-called swarming stages of development, the young would become available as oyster food. Of such types I noticed four different species, either belonging or very nearly related to the genus *Cothurnia ;* all of the forms built tubes for themselves. I also noticed several forms of bell-animalcules, the swarmers of which would become available as food for the oysters lying in the vicinity.

The diatoms did not seem to me to be more abundant in the head waters than in the open creek. There was one moss animal, of remarkable character, which I found in the head waters only, this creature was very abundant, and no doubt its embryos like those of the infusoria referred to, were available as food.

Of free swimming Infusorians, I noticed a number of genera ; one especially attracted my attention from its snake-like appearance and singularly rapid contortions ; it had a tuft of vibrating hairs or cilia at the head end in close relation with the mouth. Another more abundant type was the curious genus *Euplotes*, with a thick shell enclosing the soft protoplasm of the body ; the latter

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*On the occurrence of *Freia producta*, Wright, in the Chesapeake Bay. *Am. Naturalist*, 1880, pp. 810—11.

was of an oval form, flat beneath and rounded on the back, so that the resemblance when the large foot like cilia were in motion, carrying the animal about, was strikingly like a very minute tortoise, the resemblance being heightened when the animal was viewed from the side.

Rod-like algae, of minute size, the larvae of crustacea, especially the vast numbers of extremely small larval *Copepoda* must enter as a perceptible factor into the food supply of the oyster.

There is no doubt but that the comparatively quiescent condition of the head waters of these inlets and creeks, available as oyster planting grounds, are more favorable to the propagation of minute life than the open bay or creeks, where the temperature is lower and less constant. Practically, this is found to be true. For oystermen seem to be generally agreed that oysters "fatten" more rapidly, that is, feed more liberally in the head-waters, blind extremities of the creeks, than elsewhere. This notion of the oystermen is in agreement with my own observations during the past year. Oystermen also assert that oysters "fatten" more rapidly in shallow waters than in deep ones, a point upon which I made but few observations, but such as I did make tended to confirm such an opinion. In illustration I may contrast the condition of the oysters in the pond leased by the Commission at St. Jerome's and those dredged off Pt. Lookout in 20 or 30 feet of water, on the 3d day of October, 1880. The oysters in the pond, by the middle or end of September, were in good condition as to flesh and marketable, while those from deeper water off Pt. Lookout and but little later in the season, were still extremely poor, thin and watery and utterly unfit for market. These differences in condition, it seems to me, are to be attributed in a great measure to differences of temperature and the abundance of food, but mainly to the latter.

THE OYSTER CRAB AS MESSMATE AND PURVEYOR.

It is many years since Mr. Say named the little oyster-crab of our coasts *Pinnotheres ostreum*, and its habits in relation to the oyster seem to have excited but little interest, especially in foreign writers. Prof. Verrill, in his report to the U. S. Fish Commission, observes that it is the female which lives in the oyster, and that the male which is smaller and quite unlike the female, is rarely, if ever seen to occur, but that it has been seen by him swimming at the surface of the water in the middle of Vineyard Sound. His statement that it occurs wherever oysters occur, I cannot agree with, since out of many hundreds of St. Jerome's oysters which I saw opened, I never saw a specimen of *Pinnotheres ;* they may occur, but rarely. This little crab has quite a number of allies which inhabit various living mollusks, holothurians, etc., of which admirable accounts are given by Van Beneden in his work on *Animal Parasites and Messmates.*

There can be no doubt that the oyster-crab is a true messmate, and it is highly probable that the presence of these animals in the oyster is rather to be regarded as advantageous than otherwise. The animal lives in the gill cavity of the oyster, and, as will be seen from the following observations, may be the means of indirectly supplying its host with a part of its food. During a reconnoitering trip down the Chesapeake on the yacht "Lookout," in the first week of July last, in dredging, some oysters were hauled up which contained *Pinnotheres.* In the case which I am about to describe, the included crab was a female with the curiously expanded abdomen folded forwards under the thorax and partially covering a huge mass of brownish eggs. Upon examining these eggs what was my astonishment to find that they afforded attachment to a great number of compound colonies of the singular bell animalcule, *Zoöthamnium arbusculum.* Upon further examination it was found that the legs and back of the animal also afforded points of attachment for similar colonies and that here and there where some of the individuals of a colony of *Zoöthamnium* had been separated from their stalks, numerous minute rod-like vibriones had affixed themselves by one end. In this way it happens that there is a quadruple commensalism established, since we have the Vibriones fixed and probably nourished from the stalks of the *Zoöthamnium*, while the latter is benefitted by the stream of water drawn in by the cilia of the oyster, and the last feeds itself and its protegé, the crab, from the same food-bearing current. Possibly the crab inside the shell catches and swallows food which in its entire state could not be taken by the oyster, but in any event the small crumbs which would fall from the mouth and claws of the crab would be carried to the mouth of the oyster, so that nothing is wasted. We must consider the crab with its forest of bell animalcules in still another light. Since the animalcules are well fed in their strange position, it is but natural to suppose that they would propagate rapidly. They multiply in two ways, viz.: by dividing both lengthwise and crosswise, one half of the product being set free, and known as swarmers. These cast off germs of the animalcule colonies are no doubt hurried along in the vortex created by the cilia of the gills and palps, carried to the mouth and swallowed as part of the daily allowance of the food of the oyster. We are accordingly obliged to look upon the *Pinnotheres* in this case as a veritable nursery, upon whose body animalcules are continually propagated and set free as part of the food supply of the oyster acting as host to the crab. I do not suppose, however, that such a condition will always be found to obtain, and it must also be remembered that myriads of *Zoöthamnium* colonies were dredged up on algae from the bottom in the immediate vicinity. Such an abundance of germs in the water would favor their being readily transplanted or fixed to the body of the oyster-crab.

NATURAL BANKS.

During my stay at St. Jerome's creek, I examined the natural oyster banks which were readily accessible in shallow water, with gratifying results as to the habits of the animal under virtually undisturbed conditions.—These banks, like those of Europe, always appear to be much longer than wide, but many of them are almost entirely exposed to the air during low tide, a rare occurrence, according to Möbius, with the banks on the Schleswig-Holstein coast of the North Sea. I learned from the owners of some of these banks that, although a considerable proportion of the oysters on them were at times frozen to death during the severe winters, that the fecundity of those which remained was such, combined with the naturally favorable conditions found on the banks for the growth of old and young, as to restore the beds to their wonted productiveness in one or two seasons. Whether this description of the fecundity of the beds found in shallow water is overdrawn or not matters little, since there was the plainest evidence that we had here before our eyes the best natural conditions for the propagation and feeding of the individuals. These beds are, in a word, natural spat collecting grounds; places where such conditions obtain as will allow a large proportion of the swarming brood of the spawning season to affix itself securely and survive in positions where an abundance of food may be got. The tide ebbing and flowing over the beds not only carries with it in suspension the microscopic food best adapted for the nourishment of the oysters, but also tends, owing to the peculiar arrangement of the shells on the banks, to keep the surface of the latter clean, so as to be well adapted as favorable points of attachment for the young.

The oysters assume an approximately vertical position, as shown in the cross-section Fig. 3, of a bank in St. Jerome's Creek owned by Mr. J. W. Wrightson. The assumption of this position seems perfectly natural;

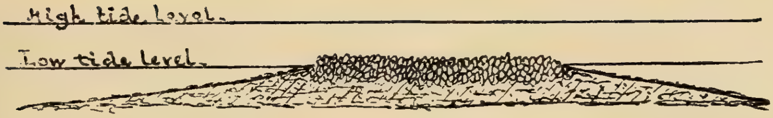

Figure 3.

with the hinge end downwards and the free edges of the valves upwards the animals are in an excellent position to feed while the outside vertical surfaces of the valves are well adapted to afford places of attachment for the "spat." The latter however seems to attach itself in the greatest abundance to the old oysters fixed at the surface of the bank. If one removes oysters from these beds they are found to adhere together in clusters as shown in Figs. 4 and 5. Carefully observing the characters presented by these masses, it is soon noticed that they consist of a series of generations which have grown one upon the other. In Fig. 4 four generations may easily be made out, as indicated by the letters *a*, *b*, *c*, *d:* in ascending order the oldest generation *a*, is represented by dead shells, which are buried in a black, sandy material, which has acquired solidity from the large quantity of imbedded dead shells which it contains. Attached to the upper edges of the dead valves of *a* follows generation *b*, which consists in part of living and in part of the shells of dead animals ; on the preceding the living uppermost generation *c* is fixed, which affords attachment to a generation of young *d*, though where there are open cavities the lower generations may bear

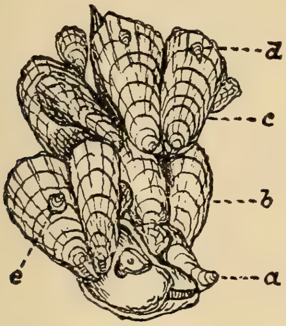

Figure 4.

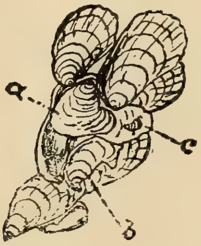

Figure 5.

spat as indicated at *e*. Whether it is proper to regard the superimposed series of individuals as generations may be questioned, but as no more expressive word occurs to me, I wish to be understood as using it here with qualifications.

The "spat," upon careful examination of these beds, we learn does not fix itself in any constant position; in some cases the young may have the hinge of the shell directed downwards, upwards, or to the right or left hand. Curiously enough the shells do not grow in the directions in which the free edges of the valves are made to assume in the young. Should the young happen to be fixed hinge downwards the free edges of the valves grow directly upwards; in case the hinge is directed either to the right or to the left the layers of lime will be deposited in such a way upon one side as to cause the free edges of the valves to be eventually directed upwards, causing the umbonal portion of the valves to describe an arc of 90°. In case the hinge is at first directed upwards the layers of carbonate of lime will be deposited in such a way by the mantle as to bring the mouth of the shell upwards as shown in the individual *a* Fig. 5. The attempt to get into a vertical position has only been partially successful however, in this last case, since the arc of 180° seems a little too much to be traversed in this way, even by the wonderful persistence of effort of the inhabitant. This struggle to assume the upright position is shown by the curved umbos and lines of growth in other individuals, both old and young, as indicated in the cases of *b c*, Fig 5. The habit of growing in the erect position, where the banks are prolific and undisturbed causes the individuals to be very much crowded together, so that they do not have a chance to expand laterally. From this cause the individual oysters become very narrow and greatly elongated; the peculiar forms which result are known as "cat's-tongues" amongst oystermen, probably from a suggestive resemblance in shape to the tongue of a cat.* Dr. C. A. White informs me that he has noticed oysters in the fossil state, which occupied a vertical position in a sandy matrix, a fact which shows that the habit so strongly marked in modern banks must be a very ancient one.

All the observant writers upon the oyster agree that it is essential that the bottom upon which oyster banks are to be permanent should not be liable to shift or be covered by mud or sediment carried to the beds by the tide waters. The comparatively meagre experience which the writer has had has strongly enforced such a conclusion. The permanent banks, owing to the great number of dead shells scattered through the bottom soil upon which they have been established, acquire a peculiar solidity or fixedness which the currents of tide water cannot sensibly affect. When once these banks are covered by the clusters of oysters more or less, securely held together by the lower portions being imbedded in the soil below, and mutually wedged together by the many surfaces of contiguous clusters becoming neatly adapted to each other by pressure, it is a very hard matter for the tides to smother the bank unless sufficient soil in suspension is carried by the waters to completely cover the animals. The inferences to be drawn from the foregoing studies are very important. They lead naturally to the inquiry whether artificial oyster beds cannot at least be established in shallow water, where the difficulties in altering the character of the bottom so as to adapt it to the wants of the oyster, are not practically insurmountable. I believe that the establishment of artificial beds in a moderately rapid tide way is possible. The localities, I apprehend, are abundant along both the eastern and western shores of the Chesapeake, and I certainly know of no place where the natural conditions offered are any better for such a project than those of St, Jerome's Creek. The bottom would of course have to undergo such preparation as would insure to it solidity, and it might be well to imitate the flat ridge-like character of the bank as shown in Fig. 3. The long axis of the beds should probably lie transversely to the direction in which the tide ebbs and flows in and out of the creeks, as appears to be the case in all the banks examined. The next thing to do would be to colonize these banks with oysters stuck thickly into the bottom, hinge downwards, imitating the position of the animals in the natural banks. The cost of an experimental bank established as I have suggested, need not be much, as the experiment could be tried as successfully on a limited scale as upon a more extensive one.

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*The crowded condition of the banks may be inferred from the fact that as many as 40 oysters were counted by me in an area included in a quadrangle of wire including exactly one square foot; 30 individuals to the square foot was a fair average on the bank examined. Where the "cat's-tongues" are developed, a much more crowded condition probably prevails.

WHY DREDGING INJURES THE BEDS.

Dredging, inasmuch as it destroys the arrangement of the oysters of the banks, tends to interfere with the fecundity of the latter. Carry on dredging operations on any given bank long enough to rob it both of its natural growth of adult oysters and in part of its natural growth of spat, it would be strange indeed if it did not cease to be productive. As we had occasion to remark above, that the uppermost tier or last generation of oysters was the one which afforded for the most part the points of attachment for the young fry, it is clear that the banks are annually robbed of vast numbers of possible oysters. True, the dead shells which are or ought to be allowed to remain on the beds, lying about amongst the living individuals also afford attachment for the young, but perhaps not more liberally than the living shells.

Another reason why dredging, especially when carried to excess, tends to destroy the banks, as insisted upon by Mobius and others, is the removal by that means of too large a proportion of germ-producing adults. It is in this way that the power of the beds to regain their productiveness is enfeebled or destroyed. Amongst the oystermen there seems to be a widespread indifference in regard to this matter, but it is to be hoped that these persons, who, more than any other class, are directly interested in the maintenance of the productiveness of the beds, will see the evils of excessive or indiscriminate dredging before it is too late to repair the damage done thereby.

The following propositions which have been laid down by Prof. Möbius, are as applicable to the conservation of our own species as to that of Europe :—

"An oyster bank will yield permanently the greatest profit if it possesses such a stock of full grown oysters as will be sufficient to maintain the fecundity of the bank in accordance with its bioconotic conditions.

"When the natural conditions will admit of it, the yielding capacity of an oyster bed may be increased by improving and enlarging the ground for the reception of the young brood.

"The natural banks should be improved by removing the weeds and plants with dredges and properly constructed harrows, and by scattering the shells of oysters and other mollusks over the bottom.

"When circumstances will permit, all the animals which are taken in the dredge, and which kill the oysters or use up their food, should be destroyed.

"It would be much more judicious and much better for consumers, if the 'close time' could be extended until the 15th of September or the 1st of October, so as to allow the oysters some time after the expulsion of the contents of the generative organs to become fat before being brought to the table.

"If it is desired that the oyster banks should remain of general advantage to the public and a permanent source of profit to the inhabitants of the coast, the number of oysters taken from the beds yearly must not depend upon the demands of the consumer or be governed by high prices, but should be solely regulated by the amount of increase upon the beds.

"The preservation of the oyster beds is as much a question of statesmanship as the preservation of forests."

The foregoing suggestions, emanating from such high authority, serve to enforce what has been said in relation to dredging and the constitution of the banks and their extension. The possibilities which seem to await development along the shores of Virginia and Maryland at the hands of enterprising oyster-culturists are almost limitless, unless, as may be the case, given areas of waters adapted to their culture, will afford food for only a given number of oysters.

FAUNA OF THE OYSTER BEDS.

The animal forms which are encountered on the oyster beds and in the surrounding waters are exceedingly numerous, and range in size from the most minute monads, Vibriones and Bacteria up to fishes and other types of considerable size. Whether the Sheep's-head *Archosargus probatocephalus*, frequents the oyster beds or not I do not positively know, but I strongly suspect that it does. My reason for this belief is that I find the half digested remains of the common branching, crimson-colored sponge *Microciona proliferum* in their stomachs, together with the crushed shells of mussels (*Modiolaria* and *Mytilus.*) These last can be best obtained by the fish from submerged rocks to which they are attached, but the sponge which grows in considerable abundance on the oyster beds would attract these animals, where they might do some damage to young oysters with their powerful cutting and grinding teeth. Other fishes are found on the banks such as the sole, *Achirus lineatus*, the true toad fish *Batrachus tau;* the outer gill openings of the latter were usually surrounded by a phalanx of parasitic crustaceans nearly allied to the genus *Caligus*, provided with a pair of discoidal suckers on the forepart of the under side of the body. Puffers (called "toads" on the Chesapeake,) were also noticed, of two species, belonging to the genera *Chilomycterus* and *Chilichthys*. Though the *Batrachus* is also called the oyster-fish, but in opening a number to examine the contents of their stomachs I found no evidence of the remains of oysters, nor does the conformation of the mouth indicate that the fish is in the habit of destroying oysters for food. The teeth of the puffers look as if they might be much better adapted to crush the shells of live oysters, especially those not over a year old. In the Museum of the Academy of Natural Sciences of Philadelphia there is a specimen of a blenny 3¼ inches in length, which was taken from an oyster 4½ inches long by Mr. C. W. Hyatt. On the inner face of both valves the fish, which is apparently a female, has laid its eggs, which are adherent, and cover nearly half the inside of both valves. Although this specimen is interesting and somewhat puzzling, I do not think that the little fish can be accused of destroying the oyster in order to make a comfortable spawning nest for itself. It seems very likely that the animal of the oyster was destroyed in some other way, and that the blenny finding the shell abandoned made it the repository for its eggs, which seem to be partially embedded in a layer of some whitish secretion.

Prof. Möbius alludes to the observation of Captain Johnston, who says, in the Report on the Oyster Fisheries, made to the House of Commons, 1876, that he saw small fishes of the genera *Gobius* and *Mullus* swallow the brood of the oyster as the latter discharged it from its parted valves, and that he afterwards caught and opened the stomachs of the fishes and found the fry in them. Since our oyster discharges its eggs directly into the water before development, when they measure only one five hundredth of an inch in diameter, I think we will not need to be alarmed about the destruction of embryos by small fishes, since I know of no species which frequents the oyster beds whose gill-rakers are close enough together to catch and hold an object as small as this.

Ascidians or tunicates were quite common and they appeared to be of but one species; one of the smooth forms of *Molgula*.

A single specimen of a small star-fish was met with. Some Pycnogonids and marine mites were noticed but not identified. Crustacea were present in great abundance, the large edible crab *Callinectes hastatus* was abundant and a few individuals were seen which were in the megalops stage of growth. Species of the genera *Sessarma* and *Gelasimus* were abundant amongst the grass along the shores of the creeks and inlets. Amphipods or sand hoppers were abundant and a number of other smaller forms were occasionally picked up while using a fine net, as well as the larvae of fish-lice (*Cymothoids*) swimming about actively in the water. The *Copepoda* were very numerous and appeared to be the principal cause of the luminosity of the water when the net or a stick was made to move through it quickly. It was these, possibly, that the Menhaden was straining out of the water as food, by means of its seive-like gill-rakers, for I always saw these fishes swimming along with their mouths held constantly open.

The entoproctous bryozoan *Pedicellina americana* Leidy, was very abundant in the pond leased by the Commissioners for the work of artificial oyster culture. Prof. Leidy, however, has either described another species than this one noticed by me, or else he has placed the stomach in a position the reverse of what it occupies in nature. The various species of ectoproctous forms I did not have the means at hand to identify; some of the creeping branched forms were common as well as a number of encrusting species.

Annelids allied to the genus *Meckelia* were found in abundance, creeping around inside of the large tubular efferent openings of a pale yellow incrusting and also massive siliceous sponge, the spicules of which were knobbed at each end. Nereids were common, of moderate size, and an exceedingly slender *Oligochaetous* worm, bright red in color, was dug up out of the sand, several inches below the surface. Planarians were quite frequently noticed creeping over the surfaces of the slate collectors.

Amongst the lamellibranchiates noticed as inhabiting St. Jerome's creek, besides the oyster, was a very destructive boring mollusk related to the true ship-worm, but generally considered to represent another genus, *Xylotrya fimbriata.* So rapidly does this creature bore into wood immersed in the sea that a small pine hatching-box which I had placed in the tide-way to retain impregnated oyster-eggs, was almost destroyed in the short space of 51 days. This mollusk is found at work at the heads of the creeks, where the water is sometimes slightly brackish, just as industriously as elsewhere. The ova, which, according to my observations, are almost identically of the same appearance and size as those of the oyster and soft-shelled clam, are produced by the animals in vast numbers and set free into the surrounding water, where they are apparently fertilized by contact with the male cells set free by the males. The embryos develop rapidly, swim about and soon find a place to fix themselves on some piece of wood in great numbers, when the work of destruction begins. These animals, in the creeks and inlets of the Chesapeake, will no doubt cause considerable trouble to oyster-culturists in destroying the lumber used in making the collectors, nurseries and other apparatus used in conducting such work.

Solecurtus gibbus is found in the sandy flats along with a species of the *Tellinidae*, where the *Mya arenaria* also abounds, which is used extensively as bait for taking the sheep's-head. The spawning season of the *Mya* is short, and begins in the early part of September and lasts until the first or second week of October. During September the large visceral mass in the middle of the shell cavity greatly and rapidly enlarges, and at this time is considered to be in good condition, or "fat," as the fishermen say. This increase in the size of the body or visceral mass is entirely due to the rapid growth of the generative organs and the ripening of the products in them. The process of coming into condition is, then, just the reverse of what occurs in the oyster. The sexes are distinct, since I never found anything except ova in the females, or spermatozoa in the males. The head of the spermatozoan differs from that of the oyster in being elongated. The number of ova set free by an adult female, judging from the relatively enormous bulk of the ovaries, must be very great, and since the eggs are of exactly the same size as those of the oyster, 1-500th inch, it is not at all improbable that there may be as many as 100,000,000 matured. I succeeded in impregnating the eggs artificially on the 13th of September last, and watched their development until the gastrula stage had been reached, when my observations came abruptly to an end.

The importance and value of this delicious mollusk is hardly appreciated on the Southern coast as it should be, and it appears to me that the artificial culture of it should be almost as much of an object as that of the oyster, with which it will compare very favorably when properly served at table.

The mussels inhabiting St. Jerome's Creek appeared to belong to the genus *Modiolaria*; no true *Mytilus* being noticed.

A few Gasteropods were noticed, consisting of three species of nudibranchiates—(without shells,) and a few very small univalves, the only larger univalve was *Littorina irrorata*, which was very common, sticking by means of the foot to the stems of the tall grass fringing the shores of the creeks. No species of boring mollusk was noticed in the waters of St. Jerome's, so that oyster-culture may probably be conducted there without harm from the *Urosalpinx*, or "drill" as it is called. There is no doubt however about their existence in some other parts of the bay. Slipper limpets were frequently observed adherent to the outside of oyster shells, the only species though, which I observed, was the one called *Crepidula glauca.* The unripe eggs of this animal have a very remarkable structure, the nucleus containing a large and very refringent nucleolus which looks like two spheres partially fused together, from this body to the walls of the nucleus granular protoplasmic lines extend in a very irregular radiating manner. These granular lines sway and twist about while the fresh egg is viewed under the microscope, like a spider's web, which may be supposed to have been endowed with life and the power of moving any part of itself. E. Van Beneden and O. Hertwig figure very similar immature ova occurring in other animals.

A number of sponges were observed; all of them siliceous; some of them incrusting stones and oyster shells, others were branching or massive and usually of a yellow, yellowish or dirty white color, except some leather sponges (*Geodia?*) which were purplish and anchored in a most remarkable manner to the bottom. The red-sponge, *Microciona proliferum* is very common, but the species which most concerns the oyster culturist is the boring sponge, the substance of which is deep orange in color. The boring sponges, *Clionæ*, are very destructive, but whether they really destroy many living oysters in this country is probably not ascertained. That they can effect the destruction of the oyster there can be no doubt from the following which I published over a year and a half ago elsewhere.* "In a specimen of the common "*Ostrea virginiana*, recently handed me for examina-"tion by my friend Mr. John Ford, the substance of the "shell was thoroughly cavernated so as to render it ex-"tremely brittle and readily crushed; in fact the inner "table of the shell left standing showed a great number

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*On the Destructive Nature of the Boring Sponge, etc. Am. Naturalist, XIII. 1879, p. 281.

"of elevations within, which indicated points where the "intruding parasite had been kept out by the oyster "which had deposited new layers of calcareous matter "at these places so as to give rise to the elevations spoken "of. Besides this, the inner table had become so weak-"ened at the insertion of the adductor muscles that the "animal in closing had broken a part of it loose, the "break having been repaired by the deposition of a "brown horny substance." In such cases, as I have just described, it is clear that serious damage may be done to the insertion of the adductor muscle, the perfect integrity of which and power to close the valves must be maintained, or there is a possibility that the oyster may be invaded by some hungry carnivorous neighbor and have its vitals eaten away without being able to shut out the intruder. In buying "plants" it would probably be best to select only such cargoes of oysters as appear to have clean unbored shells, or such as are not "worm-eaten," since I am told by a practical oysterman, Mr. J. W. Wrightson, that a bed once planted with oysters which are badly infested with *Cliona* or the boring sponge, are apt to remain so for some time and that the beds adjoining became infested for the reason that the embryo sponges which are thrown off in large numbers from the infested "plants," swim about in the water, attach themselves to other oysters commence to grow and to bore.

The protozoan fauna of St. Jerome's Creek presents considerable variety; three species of test-building *Cothurnia* were noticed, one *Vaginicola*, three species of *Vorticella* or bell-animalcules, free swimming *Euplotes*, *Nassulas*; of the latter type an exceedingly elongate form was noticed, with a body almost as slender as a thread-worm. Monads were sometimes noted in profusion, though some of these may have been the spores of algae. Amoeboid forms were very few, and the only one which was frequently noticed was a form so nearly like *Actinophrys sol* that I would pronounce it the same.

The *Freia producta* Wright, was most common; this creature is related to the fresh-water trumpet animalcules, and is one of the most beautiful protozoans I have ever seen. I reproduce here, with some changes, my description of the Chesapeake form from the American Naturalist for November, 1880. "The tubes in which "the animalcules reside are formed of a narrow trans-"parent ribbon of horny consistency, wound into a spir-"al and terminating in a trumpet-shaped extremity from "which the odd peristome of the inhabitant protrudes. "The basal or attached end is usually bent at an angle "to the tube and bears a striking resemblance to the "foot end of a stocking resting upon the sole. This por-"tion is not composed, like the tube, of a spiral ribbon, "but is simply a thin-walled sac, from the open-end of "which the ribbon takes its rise, but it is composed of "the same kind of material. Many of the tubes show a "trumpet-like rim projecting from the sides of the form-"er, a little above the middle, and of the same form as "the terminal rim, showing that this, like the form de-"scribed by Mr. Wright from British waters, may stop "building its tube for a time and then recommence.

"The adult animal tube and all, when fully extended "will measure 1-25 of an inch in length. It is of the "same color as *Stentor cæruleus*, or bottle green, but has "the power of elongating and twisting itself as greatly as "*S. roeseli*. The peristome is quite unlike that of *Freia* "*ampulla*, and bears a strong likeness to the blades of a "pair of obstetrical forceps. The blades are deeply "grooved, forming a deep ciliated demi-canal with paral-"lel saides, and at the junction of their bases lies the "spacious, twisted and spirally ciliated pharynx, which "is bounded dorsally and ventrally by the prominent "folds which unite on either side with the long curved "lobes of the peristome. There is a small basal disc "as in *Stentor*, and the ectosarc is traversed as in that "genus by parallel granular bands, regarded as muscular fibers by some writers. The usual food-balls and "vacuoles are present, and I was enabled to define "sharply the endosarc from the ectosarc, and clearly "see the long, beaded nucleus. The tube or ribbon-"secreting organ described by Wright I was unable to "discover.

"When fully extended the basal portion of the animal "becomes attenuated to a thin bluish filament, which "widens towards the peristome, where the body is over "half as thick as the inside diameter of the tube. When "fully retracted and resting, the animal resembles in its "oblong shape a retracted and resting *Stentor*, and measures about 1-10 as long as when fully extended. The "ribbon which forms the tube makes from four to twenty-"four turns in specimens of different ages."

THE FAUNÆ OF OYSTER BEDS AS INTERDEPENDENT COMMUNITIES.

Möbius calls an oyster bank a *Biocoenosis* or interdependent community of life. The many species of animals found on the banks and beds are no doubt more or less mutually dependent upon each other for subsistence, but this is perhaps not any more true of oyster banks than it is of terrestrial faunæ. There are no doubt vast numbers of floating embryos of oysters eaten by other animals growing on the beds which bring their food supply to themselves by means of currents produced by ciliary motion. On the other hand there are no doubt vast numbers of the minute swimming embryos of these, drawn in and swallowed by the oyster, which may indeed, for aught we know, in this way swallow many of its own young, for the current produced by the oyster by means of the cilia clothing its gills is by no means a feeble one, though it is exceeded in power by the current flowing into and out of the siphons of *Mya*. In the latter I have frequently, upon opening the animal, found several *Copepeda* plainly visible to the naked eye swimming about in the water in the inferior mantle cavity, which had evidently been drawn in by the inward current. It is plain in this case that very mild means may become effective as prehensile and destructive agents, so as to bring remotely related types into intimate vital relation. Though an animal may be apparently invulnerable on account of the effectiveness of its covering, it cannot emancipate itself from the abiding struggle it has to make to obtain food, no matter how passively it may appear to conduct itself. The oyster has such a character, yet it has been apparent from what has been observed before, that it is entirely dependent for a vigorous existence upon the favorableness of surrounding conditions. The beds and banks in a true sense are interdependent communities, whose vigor may no doubt be impaired by the removal of a single one of its members. Suppose we should take away the algae, diatoms, oyster crabs, vibriones, bacteria, infusoria, in fact all the minute life, we should greatly impair if not destroy the vitality of the beds. While it is true that many of even the smallest forms may destroy food which should properly be consumed by the oyster, that were it not for the presence of these same small forms some destructive element might attain such a development as to be more injurious still. There is therefore no doubt but that a delicate balance of power is maintained by these rivals which is best for the health of the community. The stability of permanent oyster beds, it must be remembered, furnishes the right conditions for the survival of many types. It is a place where they find both a home and plenty of food. It is the very favorableness offered by these places which tends to induce them to congregate and multiply, and it becomes a serious question whether the artificial establishment of banks will not in time cause the proper types to congregate and multiply so as to afford the needed food supply for the oysters. That destructive members of the community may also be attracted is admitted, but if the beds are established in shallow waters, as I have previously suggested, the destruction of such unwelcome intruders may be very readily effected. "Drills" and boring sponges are naturally to be thought of as types which should be destroyed, while diatoms, infusoria, small polyps, bryozoa, minute algae, etc., are to be favored in every way. Those forms again, which the oyster-culturist knows are there only for the purpose of getting a good living with little trouble to themselves, ought to be destroyed.

It might be an advantage to introduce certain desirable forms onto a bank, which might be supposed to be useful as a food supply. Infusoria and diatoms not previously existing might be introduced in this way ; this, I think, would be especially easy in the case of the former where the type was one which is fixed during its adult life.

METHODS OF COLLECTING AND COLLECTING APPARATUS.

Not having reached the field until the 19th of July, I did not succeed in testing the various collectors, which were for the most part modelled after those in use in France, as thoroughly as I desired. Roofing slates, tiles, shingles, oyster shells and pine cones were used to afford attachment to the young fry of the oyster; in all cases the apparatus was of course submerged, but was not allowed to sink low enough so as to be in contact with or partially buried in the mud. The most successful apparatus used was the various modifications of the slate collector, and which in practice will probably be found the most satisfactory in the long run. We first coated the slates with a mixture of lime and sand, mixed in sea-water, thick enough to cover the surfaces when dipped into the mixture with a pretty thick layer: an eighth of an inch is not too much, so that when the young fry has attained a considerable size it may be removed without injury along with the coating of mortar, a method first introduced in Europe by Dr. Kemmerer, though he used another composition. The coating should be made of a good strong mortar, about one part of lime to two of sand, and after it is applied it should be allowed to set for several days under cover before the prepared slates are made up into series in frames of various sizes and put into the water. Cement alone does not answer the purpose, as it becomes so extremely hard in the course of time that it cannot be readily removed from the surfaces to which it has been applied, which of course renders it practically useless. The slates after they are prepared were fastened into frames about two feet high, the ends being let into notches about an inch or so apart. In this way a dozen could be made up into one frame, which held them horizontally at a good distance from the bottom and far enough opart to allow the water to pass readily through between the slates, giving the floating embryos a good chance to fix themselves to the mortared surfaces. Other frames were made of an oblong shape, one foot wide and six or eight feet long, the edges of the long side pieces were deeply notched with the saw every three or four inches apart to receive the one edge of a slate, which was held in a vertical position when the frame was laid down horizontally. Some of these frames would hold twelve or fourteen slates in position at once. In other cases the slates were simply coated with mortar and laid in rows horizontally upon parallel poles supported above the bottom a few inches. In other cases again the slates were suspended upon galvanized wire by the four corners, in a tier of 4 or 5, about an inch apart. I also suspended them singly by means of galvanized wire. I did not however obtain the same results from all of the apparatus. The conditions were such however in most cases as to make it extremely difficult to make a fair comparison. Where the slates were in a horizontal position more mud seemed to be deposited on the upper side which interfered with the attachment of the spat on that side, while the comparative shade below and freedom from mud seemed to favor the fixation of the fry. The slates which occupied a vertical position did not as a whole yield results as satisfactory as those which were placed flatwise.

The tiles were not received in time to make a thorough trial, but they seem to be well adapted to retain their coating of mortar, so far as I have been able to judge from a dozen put into the water in the early part of October.

Shingles will not be adapted to the work, unless they can be protected in some way from the ravages of the ship-worm, as they will not last more than one season at the utmost, even though they were coated with mortar. The difficulty in fastening the shingles together is much greater than in arranging the slates, which also have the merit of being indestructible if properly cared for.

Chaplets of oyster shells were also tried; the shells were taken, a hole punched through the centre and strung upon galvanized wire. This form must be supported upon a framework or suspended to stakes, as the strings of shells are heavy and very quickly sink to the bottom. They have the merit of being cheaply made since the only thing it is necessary to buy is the wire, which costs but a trifle. I am told by Maj. Ferguson that this type of collector is very effective as used in practice by the French. Other shells will answer the same purpose, such as those of the white clam, etc.—Another form which was suggested by my assistant, Mr. W. P. Sauerhoff, has the advantage of being bouyant. This type was made of pine cones, of which we could obtain an abundance near the pond. They were strung on wire in the form of chaplets, six or eight of which were fastened at one end to a stake and weighted down at the other, and arranged so as to radiate like the spokes of a wheel from the stake. The cones however tend to accumulate mud which lodges between the scales; their effectiveness was not determined, since they were unintentionally placed in a rather unfavorable position.

Brush or fagots have not given the best results, as collecting apparatus they are apparently ineffectual where there is much sediment in the water, and appear to be more effective in places were the water is in rather active motion. I have been informed however, by an old oysterman, that pine bushes stuck securely into the bottom in dense lines have been found very effectual, so much so that an oyster planter following this plan had the satisfaction of seeing the bushes loaded with "spat," much of which afterwards grew to marketable size. Thick palisades might be constructed of brush stuck into the bottom near permanent oyster-banks, with good results; indeed, I do not doubt but that banks might in some cases be established by this method, if, in addition, oyster shells or stones were strewn on the bottom along either side of the brush palisade, in order to afford a foundation for the fixation of the first generations of oysters.

FLOATING COLLECTORS.

Although I have not tried any form of floating collector with much show of success, for theoretical reasons it is a form which should not be left out of consideration. After my experiments with impregnated eggs in floating boxes, some of the latter were abandoned, and upon these and the bottoms of our flat boats young oysters fixed themselves, though not more numerously than upon the slate collectors. Probably the clean black surface of the bottoms of the boats was a favorable place for "spat" to attach itself.

A form which suggests itself to me could be very simply and cheaply made. I would use common plastering laths, which should be nailed together in a simple way, say in frames two or three feet square, with the laths an inch and a half apart. Then these frames should be dipped into a mortar the same as the slates and coated with a pretty thick layer from which the attached "spat" would be readily freed. These frames I would then have arranged in lines or series with wooden floats, moored close to an oyster bank, in order that the floating embryos from these banks might the more readily find places on the surfaces of the frames to fix themselves.

Floating shingles thinly coated with cement as a protection against the ship-worm, fastened together with wire so as to form large squares, might also be used in the same situations with good results. The ship-worm might be allowed to destroy the shingles as they would still answer the purpose long enough to allow the "spat" to acquire a considerable size, and afterwards be easily broken up when it became desirable to use the "spat" in the "nurseries" or as "plants." But such a practice if long continued might prove disadvantageous, inasmuch as the cultivation of the ship-worm would also be effected, a business not at all profitable where other submerged wooden structures were in use which it was desirable to protect from this destructive creature.

The only advantages to be secured by the use of floating collectors would be in providing a means for floating embryos to fix themselves. Whether the free swimming embryo oysters will really affix themselves more freely to a floating apparatus can of course only be determined by experiment. At times it seemed to me that the collectors which had been placed nearest the surface had caught the most fry, in other cases this seemed not to be the case. There remains enough evidence however to make it desirable that this plan should be thoroughly tested.

THE BOX-COLLECTOR.

The box-collector in use in France is a rough box three feet wide, six long and two and a half deep; it is provided inside with a tier of three trays at each end nearly three feet square; upon these trays are placed dead oyster shells and a few live, spawning oysters. This was essentially the form used by me in my experiments in St. Jerome's Creek. Unfortunately, however, my experience was very adverse with this apparatus, for the reason that the sediment in the water, being carried through the openings in the sides of the box, was deposited on the shells and trays, until, in a few weeks, it had attained a depth in some places of two or three inches. Upon making an examination of the box to see if any "spat" had attached itself to the old oysters, the dead shells or the boards, I found the search useless. The mud seemed to have completely covered all the places which should have afforded points of attachment for young oysters. The live adult oysters however were found to be in magnificent condition in the latter part of September, for every available square inch of vertical board surface, or of such shells as remained clean, was covered with a forest of minute organisms, such as bryozoa, infusoria and diatoms, so that the cause of the good condition of the adults was very apparent. The probability is though, that had the pond been provided with a gate to stop the ebb and flow of the tide, that the sediment would have subsided to the bottom, and not have accumulated in the box and over its contents. Under better conditions the performance of this apparatus would no doubt have been admirable.

The use of straw-mat collectors in the same place was attended with the same difficulties as in using the box. The mats, which were made of small bunches of straw held together with a warp of galvanized wire placed every six inches apart, were so loaded with deposits of mud as to entirely prevent young oysters from attaching themselves.

MUD.

The origin of the black ooze at the bottom of our experimental pond can be traced directly to the sediment held in suspension in the water which slowly ebbs and flows in and out of the enclosure, carrying with it in its going and coming a great deal of light organic and inorganic débris, the former part of which is mainly derived from the comminuted fragments of plants growing in the creek. This seemed to be the true history indicated by what was noticed in studying the box-collector. The same opinion is held as to the origin of this mud by both Coste and Fraiche in their works on oyster-culture.

There is probably no worse enemy of the oyster-culturist than this very mud or sediment. It accumulates on the bottom of the oyster grounds, where in course of time it may become deep enough to cause serious trouble. Especially is this true of ponds from which the sea ebbs and to which it flows through a narrow channel. The falling leaves from neighboring trees in autumn also contribute to this pollution as well as heavy rains which wash deleterious materials into it.

Adult oysters which are immersed in part in this mud struggle hard to shut it out from their shells. If one will notice the inside of the shells of oysters which have grown in a muddy bottom, it will often be seen that there are blister-like cavities around the edges of the valves filled with mud, or a black material of a similar character. There is not the slightest doubt in my mind that in these cases the animal in order to keep out the intruding mud has had recourse to the only available means at its command. A great many of the oysters in the pond are affected in this manner, but it is extremely uncommon to find shells of this kind in opening oysters coming from a hard bottom. It is easy to understand that such efforts at keeping out the mud from the shell will not only waste the life forces of the animal but also tend to greatly interfere with its growth. The importance, therefore, of artificial preparation is apparent, where it is desirable to establish ponds for the successful culture of this mollusk.

Only in one case have I observed that the mud tended to impair the flavor and color of the oyster. In this instance the animal was thoroughly saturated with the black ooze, the very tissues seeming to be impregnated with the color, the stomach and intestine loaded to engorgement with the mud, the animal manifesting every sign of being in a decidedly sickened condition. The cause of this was probably that the shell with its tenant had sunken too deeply into the mud when the ingestion of the black ooze commenced, giving rise to the remarkable changes which I have recorded. No doubt had this condition of things persisted for long the animal would have been smothered by the mud.

MUD AND THE YOUNG FRY.

The accumulation of the slightest quantity of sediment around a young oyster would tend to impede its respiration and in that way destroy it, yet, in the natural beds there are so few naturally clean places which remain so, that it is really surprising that so many young oysters pass safely through the critical periods of their lives without succumbing to the smothering effects of mud and sediment. When it is borne in mind that at the time the infant oyster settles down and fixes itself once and for all time to one place from which it has no power to move itself, it measures at the utmost one-eightieth (1-80) of an inch, it will not be hard to understand how easily the little creature can be smothered even by a very small pinch of dirt. The animal, small as it is, must already begin to breath just tn the same way as its parents did before it. Like them its gills soon grow as little filaments covered with cilia which cause a tiny current of water to pass in and out of the shell. The reader's imagination may be here allowed to estimate the feeble strength of that little current which is of such vital importance to the tiny oyster, and the ease with which it may be stopped by a very slight accumulation of dirt.—Möbius estimates that each oyster which is born has $\frac{1}{1,145,000}$ of a chance to survive and reach adult age, so numerous and effective are the adverse conditions which surround the millions of eggs matured by a single female, that only the most trifling fraction ever develop as illustrated by the above calculation. The egg of the oyster being exceedingly small and heavier than water, immediately falls to the bottom upon being set free by the parent. Should the bottom be oozy or composed of sediment its chances of development are meagre indeed. Irrecoverably buried, the eggs do not in all probability have the chance to begin to develop at all. The chances of impregnation are also reduced, because the male and female oysters empty their generative products directly into the surrounding water, whereby the likelihood of the eggs meeting with the male cells becomes diminished. What with falling into the mud and what with a lessened chance of becoming impregnated, it is not unlikely that Möbius' estimate is very nearly correct, but the American oyster whose yield of eggs is much greater, not only on account of its larger size, but also because the eggs are smaller than those of the European, has probably still fewer chances of survival.* The vigorous growth of small organisms on surfaces fitted for the attachment of young oysters also tends to cause sediment to gather in such places in the interstices of the little organic forest where the eggs of the oyster no doubt often become entombed or smothered by the crowded growth surrounding them.

INTERFERENCE OF OTHER ANIMAL LIFE.

We have called attention above to the probable interference of small organic growths to the fixation of the young fry; in practice it is found that the larger organic growths which establish themselvos on the collectors, also become injurious. The two most conspicuous types are the sessile Ascidians or tunicates and the barnacles. I have frequently found fully one-half of the surface of a

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*According to estimates which I have made based on the figures of the eggs of *Ostrea edulis*, given by M. Davaine, they are 1-130 of an inch in diameter. Estimates based on the figures of Lacaze-Duthiers give 1-270 of an inch, while Möbius estimates the size of the young fry at 1-156 of an inch.

slate covered with a dense colony of ascidians ; in this condition a great percentage of available surface is lost which ought to serve for the attachment of spat. The surfaces so occupied would also be comparatively clean were it not for these organisms which actually become a serious annoyance. They, like the oyster, affix themselves to the slates while still in the free swimming larval stage, since the surfaces designed for the oyster are equally well adapted to them. The barnacles which also affix themselves in great numbers become a nuisance for the same reason. The larval barnacle is an extremely active little creature and dashes about in the water with great rapidity. As soon as it has completed this stage of its growth, it betakes itself to some object to the surface of which it attaches itself by the head end, when a singular change takes place, at the end of which it is found that it has begun the construction of the curious conical shell which it inhabits. They grow very rapidly, so that in a couple of months the shell will already measure over half an inch in diameter. In this way farther inroads are made upon the room which should be taken up by oysters.

Of course, the larger types are not alone in taking up space, since infusorious, bryoza, polyps, etc., are also culpable, as well as algae, such as diatoms and the higher forms. The only remedy for this accumulation of animal growths on the surfaces of the slates and other collecting apparatus, will be to have the frames which hold the slate in position so arranged that each tile, shingle or slate can be removed, in order that it may be readily overhauled and these organisms removed from the surfaces which it is desired shall remain clean. This work would have to be done at intervals of every two or three weeks, and should be conducted with great care so as not to remove the oysters which have affixed themselves along with the other things which it is the intention to destroy. The removal of the smaller forms from the surfaces of the slate would be more difficult and attended with danger to the fry already attached. With this object in view, I would suggest the use of wooden racks or frames lying horizontally, which would receive the slates into deep notches made with a saw, so as to hold them vertically or edgewise, rendering their removal for the purposes of cleansing and their replacement an easy matter. Other devices would no doubt answer the same purpose and be more convenient even than the last. If posts were securely fixed in the bottom eight or ten feet apart, so as to project a foot or so above the water at the highest tide, a single board six inches wide, nailed against the tops of the posts edgewise, and extending from one to the other, would provide a simple arrangement from which to hang the slates singly by means of galvanized wire fastened or hooked to nails partly driven into the board. By the help of this plan one man with a boat could overhaul many hundreds of slates in a single day and effectually care for them for a whole season. This last contrivance would not answer well perhaps where there was a swift current, but would be a most admirable arrangement in still ponds or "claires." In such places the whole area might be provided with posts grouped or placed in rows, so that when the attendant was at work he could pass in order from one row to the other in a narrow boat or two attendants in one boat could take care of two rows, the ones on either hand at the same time.

As it may be concluded from the foregoing, that the writer would have everything removed from the surface of slates except oysters, he would correct this impression. The intention is not to scrub the slates as a housemaid might scrub a floor to remove every speck of dirt, but simply to clear off the animals which are very evidently taking up room to the exclusion of more valued tenants. By some such method as that here described a careful supervision can be accomplished with little out-lay and every injurious agency can be watched and destroyed before serious damage is done.

DIFFICULTY OF KEEPING ARTIFICIALLY IMPREGNATED EGGS ALIVE.

During my sojourn at St. Jerome's Creek, experiments made with a view to keep the young oysters alive which had developed from artificially impregnated eggs, met with no better success than the attempts previously made by Prof. W. K. Brooks. The difficulties experienced were the same as those encountered by him, that is, it was found impossible to renew the water on the swimming embryos without losing many of them. Whether the mortality experienced is altogether due to the decomposition of organic material, sudden or violent changes of the temperature and weather, or a want of more frequent changes of water, I am not prepared to say. Heavy storms no doubt affect the eggs and embryos very much; sometimes mortally, as Prof. Brooks' experience as well as my own would seem to indicate. Floating boxes with muslin bottoms were tried, but with indifferent success, although the boxes were covered, violent rains seemed to kill the embryos. The muslin bottom which was employed was soon found to become loaded with organic matter and small organisms, so that it soon became practically impervious to water. The development of minute life was rapid, and the sides and bottom on the inside were soon covered with a slime loaded with vibriones, monads and infusoria into which the delicate eggs probably sank to be smothered or consumed as food by this microscopic host. Repetitions of the experiment met with the same bad success, until at the suggestion of Major Ferguson a large flannel pen was constructed into which a quantity of eggs, numbering many millions, were placed. The pen, although so large, 6 feet long, 4 deep and 3 wide, gave results of little more value; though I obtained a single young oyster which fixed itself on one of the slates suspended by means of wire from strips extending across the top of the box from one side to the other. It seemed to me, however, that there was little doubt but that the single young oyster found on the slate seventeen days after the spawn had been put into the box, was one of the embryos which had been so introduced. The flannel, like the cotton, becomes befouled in a few days with a muddy deposit held together with a disagreeable slimy material : it, like cotton and bolting cloth, rots in a couple of weeks so as to be easily torn by fishes and other water animals, such as musk-rats. Once the enclosure has been invaded by a larger animal forcing its way through the flannel, as happened in the case of the large box. one can no longer be certain that embryos naturally fertilized in the open waters may not have found their way in. The experiment with the large box was useful however, as showing that embryo ascidians and barnacles might be pretty effectually excluded by the use of textile membranes through which the water had to be strained before it could enter the box.

PROPOSED NEW METHODS OF CARING FOR ARTIFICIALLY IMPREGNATED EGGS.

From this season's experience it results that I have but little faith in floating boxes or enclosures of any kind in which cloth is used to keep the eggs or embryos confined. Few cloths are evenly and closely enough woven, if they could be kept clean, to retain in an enclosure eggs as small as the 1-500 of an inch in diameter, which is about the size of those of the oyster, clam, ship-worm and perhaps many more marine animals of various types, such as embryologists would be glad to study, provided they had an apparatus which would enable them to work continuously.

Finding that what we wanted was a device which would enable the operator to change the water on the embryos and eggs continuously and at the same time not run the slightest risk of losing a single egg from leakage, it occurred to me that the proper thing to do would be to construct a box in which the water passed through a membrane of blotting or filtering paper into the hatching chamber and out of this again through a similar membrane into another chamber and allowed to escape. In some such way it will be possible to hatch the minutest eggs and watch the reproduction, division, etc., of the very minutest monads. The idea is possibly one of immense practical value in oyster-culture and opens up a field of work in embryology in the pursuit of which many conquests are still to be made.

Another form of apparatus which suggested itself to me during my experiments with the device just described, has the advantage of being easily operated by some simple form of pump, by means of which the water may be constantly renewed in the hatching chamber. A metal ring with a bibulous membrane on either face, made water-tight around the edges of the ring, so as to enclose a space into which a short piece of tubing may be screwed at one side and connected with a pump by a rubber tube. In this way, by pumping, water would be drawn into the space included by the ring and membranes, provided these were immersed in the water contained in the hatching chamber. Of course, the membranes would have to be strengthened both inside and outside by a single thickness of stout canvas, the same as I used in making my experimental boxes, so as to have the bibulous membrane between the sheets of canvas to avoid rupturing the former, by pressure or accident. The diameter of the ring and membranes might be six inches, as more than that would probably render the membranes liable to collapse when the pump was in operation. The amount of water passing through the apparatus I should think would not need to be more than what would completely change the water in the hatching chamber once in every half or one hour, so that the pump necessary would be one of small capacity, working slowly. Probably enough ærated water would pass through the hatching chamber by being changed 24 to 48 times in the course of 24 hours, to ensure the success of this method of artificially incubating the artificially impregnated eggs. Difficulties might be experienced in keeping the membranes from clogging in the practical conduct of the work of incubation by either of the methods which I have proposed, but this could easily be remedied by filtering the water to be passed through the hatching chambers, through moderately coarse cloths, and by carefully keeping the outer canvas covering the membranes clean, and by renewing both canvas and membranes from time to time.

The importance and value of an apparatus by the help of which the oyster may be artificially hatched and taken care of up to the critical period when the young larvae fix themselves, can hardly be over-rated, because if this can be achieved a new lease of life awaits the interests of oyster-culture. There may be difficulties in the way which I have not foreseen, but the importance of the plans proposed and the schemes which depend upon them are so great that I hope to be pardoned for appearing too sanguine in my anticipations of success.

Should success attend experiments made in the way above described, so far as to keep the larvae in a healthy state up to and including the period when they fix themselves, it will be necessary to provide some kind of collecting apparatus which may be placed in the hatching chambers after it is ascertained at what age they are ready for fixation. It may also be necessary some time before the young are ready to attach themselves to provide them with food by passing unfiltered water into the hatching chamber to avoid starving them, from a hose or vessel, without its having passed through the incurrent membrane which filters out both the dirt and the food of the young oysters. The collecting apparatus which has suggested itself to me and which I think might be used with good results, should be made of small bunches of cotton wool, strips of undyed cloth, bunches of bristles, sheets of mica, and similar materials which would afford temporary attachments for the fry and which afterwards could be separated when ready to be removed to more commodious quarters cr artificial nurseries. In order to study the manner in which the fry at first fixes itself, it will doubtless be necessary to use cotton wool, thin strips of mica, or glass. It is only by this means that the true character of the attachment can be learned from the objects themselves, brought on to the stage of the microscope in an entirely undisturbed condition. Beyond the period of fixation it would probably not be judicious to retain the fry in the hatching boxes, because they are now in a condition to feed actively, and should be placed under such conditions in a supply of constantly changing unfiltered water, as will supply them with an abundance of food. This brings us to the consideration of

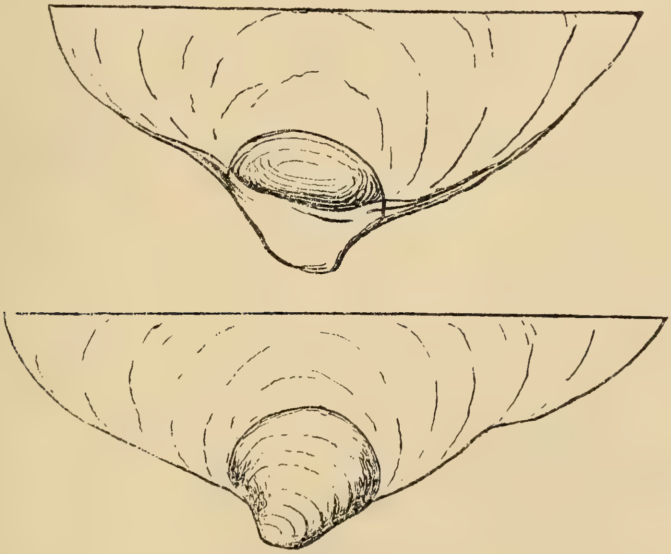
NURSERIES.

These, I apprehend, would best be made in the form of galvanized wire cages, of $\frac{1}{8}$ inch mesh cloth, inside of which a number of trays might be placed one on top of the other. These trays might in fact be made to answer as supports for the collecting apparatus in the hatching boxes, to be afterwards transferred with the affixed spat to the nursery cages. The greatest care would have to be exercised in the care of the very young fry until it was about ten days old from the time of fixation. No noxious animal growths ought to be permitted to grow upon the trays or collecting apparatus if it is possible to prevent it, nor should the fry be exposed for any great length of time to the air, which would no doubt be very injurious. The cages if totally immersed should be provided with a wire cloth cover with meshes as fine as those of the sides and bottom in order that carnivorous fishes and mollusks may be effectually excluded. After the young have grown to be ¼ to ½ of an inch in diameter they would probably thrive better in a cage made of wire cloths with coarser meshes. Here they should be spread upon trays so as not to encroach upon one another, but the care to keep them from being injured by other growths and enemies should not be abated. Finally, after being cared for until a few months old they would probably be ready to be introduced into the claires or parks, where a clean bottom should be prepared for them upon which they should be spread, so as not to interfere with each other's growth by being crowded too thickly together on the bottom.

The difficulties about the methods just proposed, are their practicability and cheapness which may be found to be insurmountable obstacles in the way of their success upon being brought into practice. And, I have only taken up so much space with a description of my plans in order that some one else may be able to test them should I be prevented from doing so, as well as to point out a new line of experiment looking to the solution of the difficult problem of the cheap and practical artificial cultivation of our noble American oyster.

OBSERVATIONS AS TO THE SIZE OF THE FRY AT THE TIME OF FIXATION.

Upon examining the hinge of young oysters carefully, it will be noticed that at the very apex of the umbo of either valve there is a very small rounded prominence. This upon examination with a magnifying power of fifty diameters is found to show faint lines of growth like the other portions of the shell. It covers like a little cap the extreme tip of the valve and appears to be somewhat raised from the other part of the shell or marked off by a groove which surrounds it. On comparing a great number of young spat we always found these little cap-like tips to the valves, and always of about the same size and shape. Remembering that the young of Gasteropod mollusks often in passing into the adult estate cement their larval shell to the tip of the permanent one, it occurred to me that these little cap-like structures on the tips of the umbos of the young oysters, must in like manner be regarded as the shell of the oyster larva at the time it attaches itself to a foreign object. Upon comparing the outlines of the supposed larval shells of our oyster with those shown in a mounted specimen of larval oysters taken from the mantle of the European species, I found the likeness very striking but much larger. These umbonal affixed larval shells measure on the average 1-80 of an inch, which is probably the size of the fry at the time of fixation and are represented in position in Fig. 6 viewed from within, and Fig. 7 from without. Previous to attachment, the right and left shells of both the American and the European species are perfectly symmetrical, and it is not until after attachment takes place that the valves show a disposition to become unlike. These larval shells in the spat I have examined are symmetrical, which is almost positive proof that they are really the temporary shelly covering of the fry when about to change its roving habit to



Figures 6 *and* 7.

a stationary one. I never failed to find the structure present, which I have just described, on young spat; after a time, as the oyster becomes older, the umbonal, portion of the shell together with the larval shell is worn off or is dissolved away by the carbonic acid in solution in the water, so that it is not to be found on the adult shell.

In examining the collection of oysters in the museum of the Academy of Natural Sciences of Philadelphia, I found that I could very easily detect the presence of this larval shell, and of about the same size, in the "spat" of four other species, viz: *Ostrea equestris* Say, from Florida; *O. conchaphila*, California; *O. cucullata*, Viti Islands, Pacific; a species which was also bored by a *Cliona; O. peruviana*, Peru. The presence of this feature, together with others, will enable conchologists to distinguish the young from adults, some of the former no doubt having supplied a basis upon which to found species.

THE RATE OF GROWTH OF THE SPAT.

Upon comparing the spat obtained from our collectors which were put out in the pond at St. Jerome's Creek, with that of the same age as figured by Coste, and Möbius of the European oyster, I find that our species grows with three or four times the rapidity of the former. For instance, Möbius figures a European oyster twelve to fifteen months old, which measures only 1¼ inches in diameter, contrasting this with the size of the American at 79 to 82 days old and measuring from 1¾ to nearly 2 inches in diameter, we see how immeasurably our species surpasses that of Europe in vigor and rapidity of growth.

Fig. 8 shows the single specimen obtained from the collectors placed in the large box or flannel pen, and supposed to be one of a lot of artificially impregnated spawn put into the box seventeen

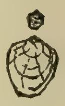


Fig. 8

days previously. It was probably not attached longer than from seven to ten days and is already as large as a young European oyster figured by Möbius as being a month old. I have sketched it both natural size and enlarged about three times to show the tiny larval shell as a sort of rounded point at the apex of the upper valve.

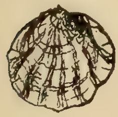


Fig. 9.

Fig. 9 shows a young oyster supposed to be not over twenty days old, and the one represented in Fig. 10 is known not to be over 44 days old, Fig. 11 is not over 48, Fig. 12, 79, and Fig. 13, 82 days old. Fig. 14 represents a very fine specimen taken from the inside of a wreck at Cape May, N. J., by my friend Mr. John Ford, and is supposed to be not over 2½ to 3 months old from the fact that it was collected in

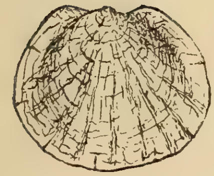


Figure 10.

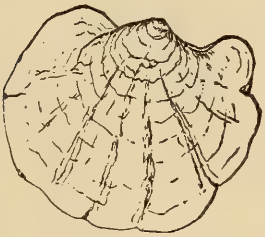


Figure 11.

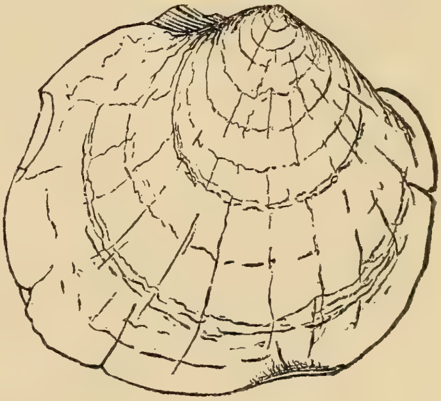


Figure 12.

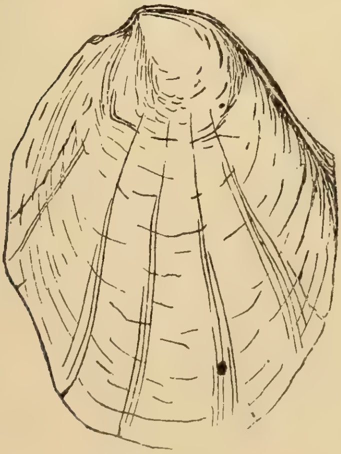


Figure 13.

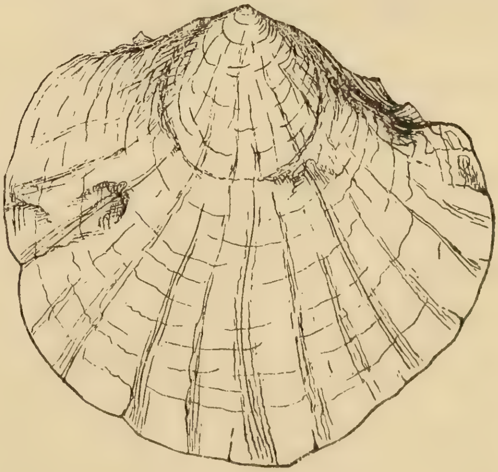


Figure 14.

July, while the shell bears every mark to indicate that it probably is of one season's growth, being spawned in the early part of the breeding term.

It will be noticed that all except Fig. 13 are handsomely rounded in shape not unlike a scallop in form, which they simulate still more by the lobes which they develop on the shell on either side of the hinge. Bands of a purplish color also radiate from the hinge, widening towards the margin of the valves, giving the spat a very much more handsome appearance than the adult, from which it differs also in having an extremely thin shell which is easily crushed or broken. The rounded forms were taken from the flat surfaces of the slate collectors, though Fig. 13, the only one noticed which exhibited a tendency to elongate like the adult, was taken from a similar surface. If the fry happens to fix itself to a roughened surface or in an angle it will adapt itself to the shape of the nidus which it has chosen. In one case I found a small oyster about a fourth of an inch in diameter attached to the outside of the plicated shell of a *Modiolaria*, and was surprised to notice that in growing and adapting itself to the wrinkled surface of its host it had reproduced in both valves all the folds on the outside of the former. I also found a specimen which had fixed itself to a dead sponge.

NUMBER OF SPAT WHICH FIX THEMSELVES TO A SINGLE SLATE.

As I have remarked above the most successful collecting apparatus was found to be the slates covered with a coating of mortar, but even these did not give the most promising results, as the greatest number of spat noticed on one slate was 8, varying from ¼ to 1 inch in diameter. This meagerness in the number of young which fixed themselves last summer may have been due to an unfavorable season. The results obtained by Captain Winslow as detailed in the report of this Commission for the season of 1880, were much more satisfactory with half-round tiles. Using hurdles or nests numbering 8 to 16 tiles, the results obtained from one placed in the Big Annemessex were very flattering. After it had been immersed 24 days 1506 oysters were counted ; after 45 days 1334 ; and after 93 days had elapsed the number still adherent was 539. In size and at corresponding ages these were similar to those which fixed themselves to the slates used at St. Jerome's. From what we know of the number which sometimes fix themselves to a single object we may yet look for great successes in the use of collecting apparatus. In one instance, the inner face of one valve of a dead oyster furnished attachment for over 40 spat from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in diameter.

CHANGES OF FORM DURING THE GROWTH OF THE SHELL.

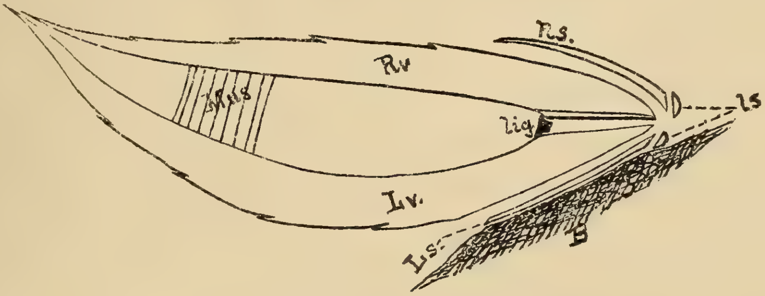


Figure 15.

In Fig. 15 we have attempted to represent the changes of shape and character of the shell of the oyster in passing from the free-swimming larval condition to that of the adult. There are three well marked stages of shell-growth, viz. : (1) the perfectly symmetrical stage attained by the valves of the "fry ;" (2) the asymmetrical stage of the "spat," and (3) the asymmetrical form assumed by the valves of the adult. In the figure, which is supposed to be a section of the shell with all its parts preserved, cut through lengthwise from the hinge end to the free edges of the valves, we note first, that the shells of the larva or "fry" *ls.* are alike in cross-section ; that the section of the "spat," which has affixed itself to a stationary basis *B*, shows that the right valves *Rs.* is concave within and convex without, while the attached left valve *Ls.* is flat conformably to the character of the basis of fixation, which is most often of this nature. Contrary to what is noted in regard to the shape of the valves in the "spat," the right valve of the adult *Rv.* is nearly flat, while the left one *Lv.* is most decidedly concave within and convex without. Other changes in the more important parts during growth are manifested mainly by the muscle *Mus.*, which moves the position of the insertions more towards the free edges of the valves, while the ligament *lig.* is moved in the same direction. Other differences in the forms of the valves at the different stages may be noticed ; for instance, the shells of the "fry" are deeply concave and very thin, the valves of the "spat" are still also relatively thin, while it is only the adult which has a very thick, stout shell, though the thickness is said to vary with the depth of the water, the thinnest shelled oysters being found in the deepest water. These deep-water oysters are known as "paper-shells" and are not liked by oyster packers and dealers, because the valves break very easily in opening them, causing additional labor in their removal. This last fact is evidence in favor of shallow-water culture.

There are good grounds for dividing the growth of the oyster into the three stages already alluded to : the first we may consider as answering definitely to the free swimming condition or that of the "fry ;" the second the thin-shelled primary fixed condition or that of the "spat ;" the third, that of the adult, which already has a pretty thick shell when a year old, when the generative organs too are in active functional use, a circumstance which has also been noticed by writers on the life-history of the oyster of Europe.

Introductory Note to Mr. Winslow's Paper.

[This paper is a desirable contribution to the literature of embryology, inasmuch as the observer has been able to follow the development of *Ostrea edulis* from its earliest phases, which has never been done before by any embryologist, although the artificial impregnation of the eggs was attempted by M. Davaine, who says he failed, and that the eggs soon became putrid and the water containing them swarmed with infusoria. M. Davaine's figures bear the marks of having been carefully made from close observations, but he obtained his material from the upper gill chamber, where the ova had already undergone all the changes represented from Figs. 1 to 16 of Brook's drawings of the early stages of the American species. Many things have accordingly escaped the notice of the French author, who did not see the "polar globules ;" the first and second periods of rest and activity at all. He also failed to recognize in the embryos with the dorsal saddle-like depression, a blastopore stage and the epibolic invagination of the hypoblast. He, however, finds that the shell originates in the position of the blastopore, as shown by Brooks. He states that the velum atrophies with the development of the mantle and gills, but does not describe the latter. He does not note the presence of a membrane around the ovarian egg, and it seems to me the membrane is a continuation of the vitelline, which forms a stalk by which the ovum is attached to the walls of the follicles of the ovary, making a channel for the passage of plasma for the growth of the ovum, as suggested by Balfour.

Mr. Winslow's paper was first offered to the Maryland Academy of Sciences for publication, but was declined on account of a want of funds to publish it, when it was offered to Maj. Ferguson, one of the Commissioners of Fisheries of Maryland, who accepted it for publication in the annual report of the Commission for 1881. It will be noticed that the author makes no claim as to his ability as an accomplished embryologist, but the observations he has made are very important, as showing that the eggs of *Ostrea edulis* can be artificially fertilized and their development watched the same as our own species.]

J. A. R.

An Account of an Experiment in Artificially Fertilizing the Ova of the European Oyster (Ostrea edulis.)

Having been engaged during the summers of 1878—9 under the direction of the U. S. Coast and Geodetic Survey upon an investigation of the oyster beds of Chesapeake Bay, and having devoted some attention to the biology of the American oyster during those seasons, such study being an incidental and partially a necessary portion of my work, I have been lead, by the interest awakened by my previous labors, and by Dr. Brooks' late successful experiment in artificially impregnating the ova of the American oyster, to attempt a like experiment with the European species. While the vessel to which I am at present attached was off Cadiz, Spain, I was so fortunate as to obtain about one hundred oysters fit for fertilization from the waters of the Bay of Cadiz, and my experiment having been successful beyond my expectations, I have concluded to lay the record of it before the Maryland Academy of Sciences, thinking that any information regarding the oyster, whether of the European or American species, could not fail to be of interest to the Academy. During the summer of 1879 I had the pleasure of witnessing the experiments of Dr. Brooks, which he has detailed in his paper upon the Development of the American Oyster, and with which the Academy is doubtless familiar, and in conducting my own experiment I have followed his method as nearly as possible, and have used his figures in describing the development of the European animal. I can therefore lay no claim to originality in either the conception or execution of the experiment which I undertook, and I am but a follower in Dr. Brooks' footsteps. As however, this is, so far as I am aware, the first attempt to artificially impregnate the eggs of the European oyster, and as the inferences which can be logically drawn from its success affect the theory of the reproduction of the animal and the development of its eggs to the same extent as those drawn from like successful experiments affect our own species, I have thought my work might prove both of interest and of value.

I labored under many disadvantages, and with a very inferior microscope, though magnifying 300 diameters, of obsolete pattern, and at times had to contend with the irregular motion of a vessel at sea and the deficient light afforded by lamps. All my appliances were such as I could obtain or improvise on board ship, and their rudeness and the inconvenience they caused hampered me a good deal in conducting the experiment. I regret that my observations were not more systematic, regular and frequent, but a naval officer has but few moments which he can safely call his own, and my official duties necessarily compelled my frequent and prolonged absence from the microscope.

HISTORY OF THE EXPERIMENT.

The oysters were obtained from the mouth of St. Mary's River, in the Bay of Cadiz, Spain, and were natives, the variety having existed and flourished in the Bay for as far back as could be remembered. In appearance they were quite similar to the American species (*Ostrea virginiana*), having long shells of from one to three inches in length, rougher and thicker than is usually the case with the European oyster ; there were no clusters however, all the animals growing singly, and but a very few young of the previous season were attached to the shells; those noticed were probably nine or ten months old, and though certainly of the brood of the previous season were small sized when compared with the American oyster of the same age. The adults were about the size and of the appearance of the Chesapeake Bay oyster when about two years old. The animals when divested of their shells were larger than those of the same species from other localities, and were all in good condition, the ova and spermatozoa being ripe, in many cases oozing from the oviducts, and in all cases in admirable condition for artificial fertilization, the eggs being well defined, and with but little granular matter among them, while the spermatozoa were exceedingly active.

I had intended to examine carefully the ovaries, gills and mantles of all the oysters at my disposal with the intention of detecting the existence, should there be any embryos within the shell, but the pressure of other duties and the disadvantages under which I labored left me but little time and few opportunities to devote to the matter, and consequently I am unable to state positively that in some among the limited number in my possession, the embroys were not fostered within the shell of the parent. I was able to examine between twenty and thirty oysters only ; these at least contained no embryos, though some of them were expelling the contents of the generative organs, as I found on the gills of two, ova unimpregnated, and on the gills of another, spermatozoa.

In making the experiment I followed carefully the method of Dr. W. K. Brooks, as described by him in his paper on the development of the Americon oyster, (Report of the Commissioners of Fisheries of Maryland, 1880,) and I am compelled to refer to his figures, given in that report, from the want of suitable instruments and conveniences for making those of my own. As I carefully followed the development of the eggs through each stage, comparing those under the microscope with the figures at frequent intervals, as the successive stages of development are well marked, and as I have witnessed many of them in company with Dr. Brooks, and have likewise observed them while working independently during the summer of 1879, I think my observations may be relied upon and assigned a greater value than those of most amateurs.

THE ARTIFICIAL IMPREGNATION OF THE EGG.

Two ripe males were selected, the spermatozoa from which was very active, and the visceral mass was cut out; all parts of the digestive organs were then removed, leaving the generative products in the saucer. The latter were then chopped up as finely as possible and mixed with salt water, and the fragments of the digestive organs, mantles and gills carefully washed out, and this process was repeated several times until the male fluid was free from all deleterious matter. Two female oysters were then treated in a like manner, and finally both male and female fluids were mixed thoroughly in a glass holding one half pint of clean salt water. The fertilization was accomplished at 8.05 P. M. on June 6th. The following are the noted times of the principle changes during the process of segmentation and subsequent development:

8.12 P. M. The eggs were irregular in shape and covered with spermatozoa—germinative vesicle plainly visible—appearance exactly as figured by Brooks. (Report Com. Fisheries, Maryland—Pl. VIII—Fig. 51.

8.32 P. M. Germinative vesicle had disappeared and eggs nearly similar to Brook's fig. 52, though not so regular in outline.

The water was now siphoned off and the glass half filled with fresh sea-water.

10.03 P. M. One hour and fifty-three minutes after fertilization, the eggs had become elongated, and the polar globule was easily observed. In a few eggs the separation of the micromeres and macromeres could be distinguished. The appearance of the eggs was as is shown in Brook's figs. 2, 3, 4 and 5, the larger number resembling figs. 2 and 3.

At 11.10, about three hours after fertilization, all the eggs examined had passed through the first stage of activity, and as far as could be decided had reached the second period of rest—resembling Brook's figs. 8, 9 and 10. I was called away from the microscope at this time and was unable to trace the changes during the second period of rest or to note the time of their occurrence.

At 1.27 A. M., or five hours and fifteen minutes after fertilization, the eggs had passed through the second period of activity and had entered upon the third period of rest. In some of them the four micromeres were easily observed, but in others they were not so distinct; a few were as figured by Brook's (fig. 16), but the majority appeared as in figs. 18 and 19.

I was unable to follow the intermediate changes between those of the third period of rest and those of the first swimming stage, but at my next observation, at 4.30 A. M., on the 7th, larger numbers of eggs had reached the latter stage and were swimming at the surface of the water. The cilia were well developed and the movements of the embryo very rapid—their appearance was exactly as figured by Brooks' figs., 32, 33, 34 and 35. The water in the glass was now siphoned off, into a jar, that the embryo might have room for development and be free from the influence of decaying eggs; but as I had but two fruit jars holding a quart each, with which to conduct my experiment, I was forced to take many eggs into the second receptacle before they had developed swimming powers, or else sacrifice them. As the rate of segmentation was very irregular, I had for a time, what was to me, a rather confusing mixture of eggs in the process of segmentation and developing embryos; but with care and close observation, I managed to follow each lot until they reached the swimming stage and could observe no difference between them and the first, except in the rate of change from one period to another.

At 12.30 P. M., June 7th, or sixteen and a-half hours after fertilization, there were many eggs in the first swimming stage, but the majority had only reached the later periods of segmentation, appearing as figured by Brooks, in Nos. 25, 26, 27.

At 8.00 P. M., there were large numbers in the first swimming stage at the surface of the water, the cilia were well defined and active ; in many cases the polar globule was still observable. The majority of the embryos appeared as figured by Brooks, in Nos. 32, 34 and 35, while a few were in more advanced stages, appearing as in 36 and 37. The pressure of other duties prevented my continuance of the observations after 11 P. M. until 11 A. M. on the 8th. At that time the majority of the embryos were as figured in Nos. 36, 37 and 38, the latter stage predominating. The shell was remarkably well defined in several, but the activity of the embryo and the rudeness of the instrument used, prevented my deciding with certainty as to the extent of the development of the digestive tract or the presence of either the mouth or anus.

At 11 P. M., on the 8th, or two days and three hours after fertilization, I found one embryo that so exactly resembled figure 36, that it might have been the original from which the figure was drawn. About this time I experienced my first difficulty in finding specimens, but my observation of those embryos discovered was very careful and close, and I have no doubt that their development so far was similar to that of our own species. Subsequent to this time, the intervals between my observations were greater, owing to the necessity of my employment upon other duty ; and my absence from the vessel compelled me to put the embryos under the care of others ; consequently in the intervening hours, changes may have occurred which are unknown to me, and many of the embryos may have advanced beyond the latest stages which came under my observation, but so far as I know, none advanced beyond those stages figured by Brooks.

At 3.00 P. M., on the 9th, or two days and nineteen hours after fertilization, owing to the increased amount of water in the jar (I had by this time obtained a large one,) and to the mortality among the embryos, I found it very difficult to find any, and this difficulty was a constantly increasing one thence forward. Those specimens obtained had well developed shells, and the digestive tract could be readily distinguished, as could the cilia. The movements of the embryo were so rapid and erratic that I found great difficulty in keeping them under the high power for a sufficient time to decide as to the stage they had reached, but those least advanced appeared as figured by Brooks, in No. 38, while the older embryos presented the characteristics of figs. 39 and 42.

At 11 P. M., on the 10th, or four days and three hours after fertilization, the digestive tract and shells were readily distinguished, especially the latter, which were very apparent. The anus was observed in several cases and the course of the intestine from it to the stomach easily traced. The cilia of the velum was also apparent, even with the low power. The main features at this time were similar to those of figs. 42 and 44.

At 11.00 P. M., on the 12th, or six days and three hours after fertilization, the embryo had apparently undergone little or no change, except that a much larger number had reached the stage shown in figure 44. In all, the shells and digestive organs were well developed and apparent, and the movement of the cilia of the velum regular and rapid, though the cilia appeared to have decreased in size.

At 11.00 P. M., on the 13th, seven days and three hours after fertilization, there was no apparent change in those embryos that could be found. They appeared quite healthy and were rapid in their movements. The difficulty of obtaining specimens, however, had much increased.

At 11.00 P. M., on the 14th, eight days and three hours after fertilization, I could only find a very few embryos after a long, patient and careful search, which occupied several hours. Those discovered were similar in all respects to those last described, and as figured by Brooks, in No. 44.

On the 15th, I met with a total failure in my search for the embryos, and it was both long and carefully conducted, and the same want of success attended me on the 16th, when I gave up the attempt to further trace the development.

It will be observed that I could not find any embryos of a more advanced stage than those figured by Brooks, and that owing, probably, to the irregular rate of segmentation, I found them at the latter stages at periods varying from three to eight days.

It is not probable that the disappearance of the embryo was due to a deficient supply of water, for during the latter days of their existence they were far more liberally supplied than before. Neither is it probably due to change of temperature, for, as will be seen by the following tables of maximum and minimum temperatures, the range of temperature was about the same throughout the eight days :

Date.	*Max. Temp.*	*Min. Temp.*	*Diff.*
6	71°	70°	1°
7	71°	64°	7°
8	73°	64°	9°
9	79°	60°	9°
10	75°	62°	13°
11	74°	60°	14°
12	71°	61°	10°
13	77°	64°	13°
14	75°	66°	9°
15	72°	64°	8°

The water supplied to the embryos was always allowed to stand a sufficient time to acquire the temperature of the air before being added to that already in the jar.

It is a coincidence at least worthy of notice, that with both species the embryos have disappeared at about the same stage of development.

All published accounts of the development of the European oyster agree in asserting or assuming that the impregnation of the ova occurs while they are either within the ovaries or shell of the parent, and that consequently artificial fertilization is impossible; this supposition my experiment effectually disproves. Again, should the artificial fertilization of the eggs and subsequent care of the embryo of the American species reach such a state of perfection as to make the process an addition to oyster culture, and one of practical importance, the agreement of the European species with our own in the early stages of development, will indicate a method by which the supply of oysters may be increased in localities whose need is even now far greater than our own.

In conclusion, I must express my indebtedness to the paper of Dr. Brooks upon the development of the American oyster, to which I have alluded, and without which I should have been somewhat at a loss for a means of registering the various changes which I witnessed in the development of the European oyster.

Respectfully, FRANCIS WINSLOW,
Master U. S. Navy.

U. S. Ship "Saratoga," at Sea; July 5th, 1880.

BIBLIOGRAPHY OF LITERATURE RELATING TO OYSTER CULTURE.

Arcana Naturæ detecta ab Antonio Van Leeuwenhoek, 8 vo., Lugduni-Batavorum. MDCXCV.

The antiquated memoirs of Willis, 1672; Lister, 1678; Jac. Brach, 1689, are now more curious than useful. Méry, (Mém. de l'Acad. des Sciences, 1710;) Adanson, (Histoire Naturelle des Coquillages;) and Joh. Baster, 1762, considered the oyster hermaphrodite. Th. Sprat in 1669 compared the fry to a drop of melted tallow which had fallen on a solid body and hardened, remarking also that it commenced to form a shell in 24 hrs. M. Deshayes, in 1846, was the first to indicate the true position of the reproductive organs. Little exact knowledge had been acquired, however, previous to the time of Davaine, Lacaze-Duthiers and Coste, from 1852 to 1857. To Leeuwenhoek belongs the honor, however, of having made the discovery of the existence of spermatozoa; he believed moreover, that the sexes were separate, a conclusion which is now well grouded so far as the American oyster is concerned, while it is apparently to a great extent true of the species which the famous inventor of the microscope studied nearly 200 years ago.

Testacea Utriusque Siciliâe eorumque Historia et Anatome. J. Poli. Folio. Parma 1791—95.

On the propagation of the common oyster and the large fresh-water muscle. Croonian Lecture for 1826, by Sir Everard Home. Phil. Trans., 1826, 4 to., pp. 39—48, pls. III.—VI.

De Danske Östersbanker, H. Kröyer. Kjöbenhavn, 1837.

Recherches sur la Génération des Huitres. Par C.

Davaine. Mém. de la Soc. de Biologie. t. IV. 1 e Ser. 1852, 8 vo., pp. 295—339. pls. II. Paris.

Organes génitaux des Acéphales Lamellibranches. par H. Lacaze-Duthiers. Ann. des Sc. Naturelles. 1854.

Mémoires sur le Système Nerveux des Mollusques Acéphales Lamellibranches ou Bivalves. Par M. Duvernoy. Mém. de l'Académie des Sciences, de l'Institut de France. t. XXIV., 4 to., pp. 210, pls. 13—Paris, 1854. (The most elaborate treatise on the nervous systems of bivalves.)

Des organes de la génération de l'huitre. H. Lacaze-Duthiers. Comptes rendus. tome XL. 1855. pp. 415—420.

Guide Practique de l'Ostréiculture. Par Prof. Felix Fraiche.

History of the Oyster and Oyster Fisheries. By T. C. Eyton, London, 1858.

Voyage d'Exploration sur le Littoral de la France et de l'Italie. par P. Coste. 4 to., 2 Éd. Paris, 1861.

Mind in Nature; or the origin of life, and the mode of development of Animals. By Henry James Clark, 8 vo., pp. 322, D. Appleton & Co., New York, 1865. (Discusses the Anatomy of the Oyster.)

Études sur l'industrie huitrière des Etats Unis. par P. de Broca. Paris, 1865.

Report on the Oyster and Mussel Fisheries of France made to the Board of Trade by Cholmondeley Pennel, Inspector of Oyster Fisheries. London, 1868.

Notizen über Austern-Cultur. von Richard Ritter von Ergo. (6 maps.) 8 vo., pp. 57. Triest, Buchdruckerei des Oesterreichischen Lloyd, 1869.

Den Konstige östersavl og den Sudförelse i Danmark. F. Krogh. Hadersleben, 1870.

Ueber Austern and Miesmuschelzucht und die Hebung derselben an den norddeutschen Küsten. von Dr. Karl Möbius (19 wood-cuts.) Sm. 8 vo., Weigandt, Hempel & Parey. Berlin, 1870.

Report of the Commission appointed to examine into the Methods of Oyster Culture in the United Kingdom and in France, with a view to the Introduction of Improved Methods of Culture of the Oyster in Ireland. 1870.

Untersuchungen uber die Fortpflanzungsverhältnisse der Schleswigschen Austern. von Carl Möbius. Nachr. d. deutchen malak. Gesellsch., III. pp. 129. Frankfurt, a. M. 1871.

Die Austernzucht und Seefisherie in Frankreich und England. von A. Tolle. Sm. 8 vo. Berlin, 1871.

Om östersfiskeriet i Limfjorden. Af. J. Collin.—(With a chart of the oyster banks.) Kopenhagen, 1872.

Observations on the Food and Reproductive Organs of Ostrea Virginiana, with some account of Bucephalus Cuculus. By Prof. John McCrady, Proc. Bost. Soc. Nat. Hist. 1873.

Report on the condition of the sea-fisheries of the South Coast of New England in 1871 and 1872. Washington, United States Fish Commission Report, 1873. (Oyster-beds, p. 472, by A. E. Verrill.)

Bemerkungen ueber Haeckel's Gastraea-Theorie. von Prof. W. Salensky, Arch. fur Naturgeschichte, XL., 2 Hft. Berlin, 1874. (Figures some embryo oysters.)

Notice sur la situation de l'ostréiculture en 1876.—(Extr. de la Revue maritime et coloniale.) Paris. 1875.

Om vore Haves Naturforhold med Hensyn til Konstig östersavl og om de i den Henseende amstillede Forsög. G. Winther. Kopenhagen. 1876.

Report from the select Committee on Oyster Fisheries; together with the Proceedings of the Committee, minutes of evidence, Appendix and Index. Ordered to be printed by the House of Commons. July, 1876.

Z. Gerbe, in Zoological Record, 1876, XIII., Mol. 62. [This author states, according to Fischer, (Manuel de

Conchyliologie,) that the velum of the embryo becomes the palps of postembryonic life.]

How can the Cultivation of the Oyster, especially on the German Coast, be made permanently profitable.—(Rept. U. S. Commission for 1876—'77), 8 vo., pp. 875—884. Translation by H. Jacobson of an Address made at the German Fishery Association, 1876, by Karl Möbius, from Circular No. 3 of the Deutsche Fischerie Verein, Berlin, Mar. 21, 1877.

Rapport addressé au Ministre de la Marine et des Colonies sur l'Ostréiculture. par M. G. Bouchon-Brandely. (Publie dans le Journal Officiel de la République Française, le 22. Janvier, 1877.

Die Auster und die Austernwirthschaft. von Karl Möbius. (One map and nine wood-cuts.) Sm. 8 vo., pp. 126 Berlin. Weigandt, Hempel & Parey. 1877.

Notice sur l'huitre Portugaise et Française, cultivée dans la Baie d'Arcachon. par J. Renaud. 4 to pp. 33. Arcachon, 1878.

Rapport au Ministre de l'instruction publique sur la pisciculture en France et ostreiculture dans la Mediterranée. Par Bouchon-Brandeley, 8 vo., p. 113. Wittersheim & Cie, Paris, 1878.

La Pisciculture et les Parcs à Coquillages de la rade de Toulon. Par L. Turrell. In Bull. de la Soc. d'acclimation, Paris, 1878.

Translation of a Report made to the Minister of Marine in France, by M. G. Bouchon-Brandely, relative to Oyster Culture on the shores of the Channel and of the Ocean. [Not able to supply the date and place of publication.]

A number of articles on the tools used in taking and rearing oysters, as well as figures of patented apparatus, are given in the octavo report of the U. S. Fish Commission for 1878. Washington, 1880.

The Development of the American Oyster. (Ostrea Virginiana List.) By W. K. Brooks, Associate in Biology, Johns Hopkins University. 8 vo., pp. 81, pls. X. (In Report of Commissioners of Fisheries of Maryland, 1880.)

The same, published as Contribution No. IV, of Chesapeake Zoological Laboratory, Johns Hopkins University, (a reprint of the preceding) with a paper added, entitled: The Acquisition and Loss of a Food-Yolk in Molluscan-Eggs, 8 vo., pp. 107—116, pl. XI. John Murphy & Co., Baltimore, 1880.

NOTES

ON SOME OF THE

EARLY STAGES

OF

DEVELOPMENT OF THE CLAM,

OR MANANOSE.

(*Mya arenaria Linn.*)

BY

JOHN A. RYDER.

NOTES ON SOME OF THE EARLY STAGES OF DEVELOPMENT OF THE CLAM OR MANANOSE (Mya arenaria.)

The spawning period of this mollusk lasts from the 10th of September to about the middle of October, or for about forty days. The sex of the adults, in a spawning condition, may be very easily learned. Open the shell of the animal carefully, remove a small portion of the richly colored yellow body mass with a knife, scissors or forceps. These fragments, squeezed or "teased out" in a watch-glass with a few drops of sea-water, allow a milky fluid to escape. Under a magnifying power of four or five times, the eggs of the female are visible in this milky fluid as very minute white points of nearly uniform size. The male cells are too small to be seen with the aid of so low a magnifying power, and the fluid retains its milky apqearance just as it does to the naked eye. It is only under high powers, as much as 250 diameters, with the compound microscope, that the spermatozoa or male cells may be made visible, as minute oval bodies with a long, lash-like tail in rapid motion. These differences enable the operator to distinguish the sexes, after a little experience ; indeed, it is possible with training, to note the differences between the male fluid and the eggs of the female when removed from the animals, with the naked eye.

Artificial impregnation of the eggs was effected in the same way as in the case of the oyster ; that is, portions of the ripe ovary of the female are removed and chopped up in a watch-glass or small saucer with sea-water, taking care to remove all the large fragments of ovarian tissue by straining the milky substance through bolting cloth, which will allow little else than the eggs to pass through its meshes. The spermaries of the ripe males are treated in the same way in another saucer, after which the male cells mixed with sea-water may be poured into the dish containing the eggs. In two or three hours after the water containing the male cells has been poured over the eggs, development will have begun. The water should now be removed from time to time by pouring it out of the dish or tumbler, taking care not to stir up the eggs which have settled to the bottom. Soon, however, the embryos will begin to swim, when it will be necessary to remove the water in another way, or with the siphon.

The changes which occur in the eggs during development, succeed each other with considerable rapidity, and, as in the development of the oyster, there are very well-marked periods of active change of form, which alternate with periods of repose, while there is a bilateral symmetry which is just as well marked as in the latter and *Unio*. A power of 250 diameters enlarges the eggs satisfactorily; shows the freshly impregnated eggs as spheres measuring ½ inch in apparent diameter, a proof that the actual diameter of the eggs is very nearly 1-500th of an inch. The eggs are not spherical when first removed from the ovary, but are usually irregular in form with a more or less well pronounced conical extremity, by which they were attached to the walls of the ovarian follicles. The other end is more or less irregularly rounded. A nucleus is plainly visible during this irregular stage, but no well defined egg-membrane is apparent.

The early stages which I was enabled to figure may not entirely cover the different phases through which the embryos pass at that time, but in view of the circumstance that there is but little known of the development of Lamellibranchiate or bivalve mollusks, and that little relates to but few forms, I feel justified in offering the results obtained from a study of the embryonic development of the Clam, which has not been studied hitherto. Though

I did not succeed in following the development farther than to the formation of a gastrula, and was not able to time the changes which were observed, owing to the fact that my watch was broken, I still hope to be able to make a series of observations which will include the later stages.

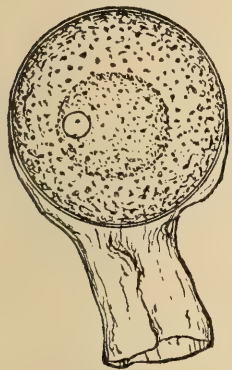


Figure 1.

Fig. 1 shows an egg which has been removed for some time from the ovary ; the vitellus composed of minute corpuscles or spherules has assumed a rounded form, a nucleus is still visible as well as a clear nucleolus within it ; the vitelline membrane has become defined, while the delicate thin membrane which held the eggs fast to the wall of the ovarian follicle remains attached as a transparent structureless film. It is the supposition, based upon the conclusions of other observers, that at this stage impregnation has not yet been effected. This is effected by the entrance of a single spormatozoan or male cell into the egg through the vitelline membrane, but as I have not noted a micropyle, either in the eggs of this animal or that of the oyster, it is very probable that the male cell finds its way into the vitellus through an opening in the vitelline membrane extemporized for its passage. We are, at any rate, not yet ready for a general conclusion as to the presence or absence of a micropyle in the Lamellibranchiate cvum, to which Balfour in his *Comparative Embryology*, Vol. I., p. 31, commits himself. The histology of the ovaries of more forms must be studied before we can decide, and no more promising field is open before us than the investigation of the ovogenesis of the oyster and clam, both of which are still unstudied in relation to this point.

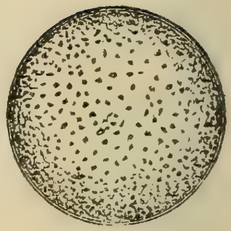


Figure 2.

Fig. 2 represents an egg of the clam after the lapse of perhaps two hours from the time it was first brought into contact with the male cell; it has apparently been impregnated, for the nucleus and nucleolus are no longer visible. It has also become perfectly spherical and has lost the membranous, filmy appendage of Fig. 1.

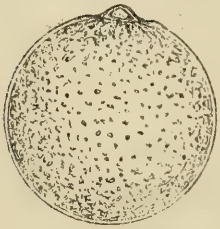


Figure 3.

Fig. 3 exhibits the same egg still later when the first polar cell has appeared as a minute blister-like prominence at one side. The polar cell is almost transparent and is situated in a slight depression, from which impressed lines radiate, making it appear as if the vitelline membrane were wrinkled in a radial manner. A similar radial wrinkling around the polar area is described by Whitman as occurring during the formation of the polar cells of the egg of a small fresh-water leech (*Clepsine*), but it is more strongly marked than in the egg of the clam. I have not noted this radial wrinkling in the egg of the oyster. After a while the egg represented in Fig. 3 undergoes farther change, a series of annular waves pass from the pole of the egg opposite the polar cell and a second polar cell is pushed out, when the radial wrinkles disappear and the polar cells present the appearance of two small spheres joined to each other and attached to the egg by a stalk as in Fig. 5. I should have stated before that the first polar cell originates in the same way as the second—by the passage of a series of waves from one pole to the other. These are not all of the forces that are at work in the extrusion of the polar cell; the nucleus of the egg has been undergoing changes of form, elongating and contracting, disappearing to assume a spindle form, then contracts into a rounded form, but with one end in intimate relation with the polar cells. These changes of form seem to constantly accompany the expression of all the phenomena of active change in living cells, such as growth and division. Networks have been described in nuclei; the latter are known to expand and contract; elongate in the direction of certain lines of force; again withdraw into a globular form, so that Flemming has proposed the terms diastole and systole for these wonderful phenomena, which suggest, if they do not prove, the existence of forces of repulsion and attraction in active labor in the heart of every living cell. We have these phenomena presenting themselves to our vision in the eggs of the oyster and clam. The protoplasm of the egg tremulous with an intense life pent up and energetically trying to unfold itself soon causes the vitelline membrane to quiver and work in rolling waves and the egg assumes very rapidly the form shown in Fig. 4 as seen from below, and Fig. 5 as seen from the side. The two centres of force or nuclei are here indicated as two small clear spheres near the central part of the two cells which have been defined by a period of activity just past. The forces of growth now remain quiescent for a space, to be exhibited in one of their supremest moments of activity in Fig. 6, in which a portion of the largest cell or megamere is being separted to form a smaller cell or micromere. At the same time what was the small cell or micromere in Fig. 5 is as energetically dividing into two smaller cells or micromeres. The result is three micromeres. Looking more closely at the figure we see what appear to be lines of force running from the faintly marked nuclei of each of two cells to that of two others. The nucleus of the large cell is in vital relation with that which is budding from

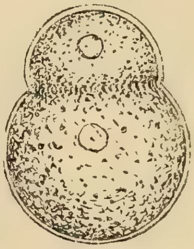


Figure 4.

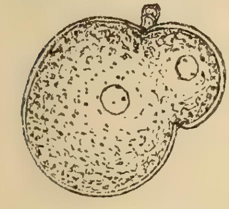


Figure 5.

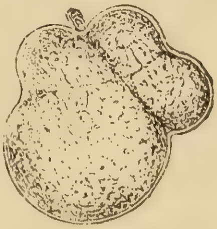


Figure 6.

it. So too, are the two small ones originating from the smaller cell of the stage shown in Fig 5. The notch which is moving inwards to nip off the small cell from the large one moves so fast that I find the camera lucida of use only so far as it enables me to get the dimensions. In like manner the contour lines on the other side are rapidly changing in the division of the smaller cell. Then follows a condition of rest shown in Fig. 7. The micromeres are now three in number, the megamere is still much greater in bulk than all three. The nuclei again become defined. The egg is passing slowly into the stage shown in Fig. 8, at the one pole of which we still see the polar cells persisting. The three micromeres have subsided; become depressed and the whole outline is more rounded, like that of the unsegmented egg. The faint indication of a segmentation cavity or space shown between the micromeres and megamere in Fig. 7, has disappeared. The embryo is quiescent and has reached the limit of perhaps its third or fourth period of activity and rest. The succeeding stage represented in Fig. 9 is where the next period of activity has reached its completion. The micromeres of Figs. 7 and 8 have again divided and one or two micromeres have been derived from the megamere; in this way a number of additional micromeres has been the result. The micromeres are now piled up at one side, or rather end, of the egg, and the polar cells still persist. The micromeres display a certain symmetry of arrangement. It now becomes apparent that the micromeres are to be the foundation of the epiblast or skin layer of the embryo, while the micromere is to become the hypoblast or inner layer from

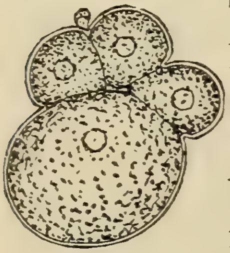


Figure 7.

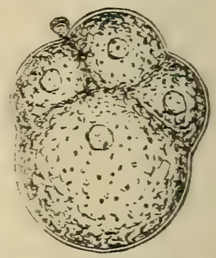


Figure 8.

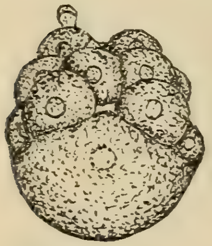


Figure 9.

which the stomach and intestine is to be developed. In Fig. 9 the micromeres are slowly creeping down over the megamere which is finally enclosed by the former growing in a single layer from above downwards. This mode of developing a two layered stage of the embryo is known as epiboly, meaning that the epiblast grows over and upon the hypoblast which is here represented by the megamere. The megamere is finally pushed inwards and covered by the micromeres or cells of the epiblast. Once fairly inside and included by the epiblast as shown in Fig. 10, the megamere begins to divide as shown by the darkly shaded cells in the lower part of the figure. A depression appears in the middle of this cluster of cells which must, on anatomical grounds, be considered the orifice of invagination of the hypoblast. This orifice or blastopore may be considered the mouth of the so-called gastrula or stomach-stage of development, but it is never used as an inlet for food, which is not yet usable by the larva. The depression however persists, and there is every reason to believe that, like in the oyster and fresh-water mussel, it is the point where the shell-gland of the embryo develops and that it therefore marks the position of the back of the animal. Fig. 10 also illustrates plainly the position of the outside skin layer or epiblast *Ep.*, from which the mantle, gills, and siphons of the adult are derived, and its relation to the darkly shaded hypoblast cells *Hy.* inside, which finally become fully covered by the epiblast so as to appear like a cluster of cells in the inside of the hollow sphere formed by the latter. The central cluster may now be looked upon as the archenteron or primitive foundation from which a true stomach is derived.

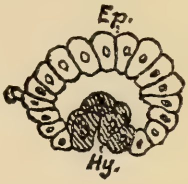


Figure 10.

The way in which the gastrula stage of the clam is formed is so far unquestionably the same as that of the oyster ; what lies beyond we cannot say, but it is in the highest degree probable that the history of its later stages is much like that of the latter. Since we have been led along so far it will perhaps be profitable to inquire into the next phase of the oyster as throwing light upon the origination of the permanent mouth, stomach and intestines. Fig. 11, which I have copied from Salesnky, represents the larva of the European oyster at a stage considerably farther advanced than my Fig. 10 of the clam. I have inverted the original and changed the lettering somewhat, in order to make the figure correspond in position and to make the names of the parts agree with the nomenclature which I use.

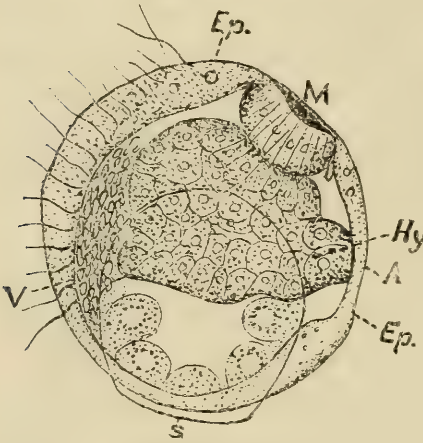


Figure 11.

The depression at *Hy.* in Fig. 10, has disappeared in Fig. 11 and the shell *S* covers the spot. It will be noticed too, that the hypoblast *Hy.* has arranged itself anew and has been broken up into smaller cells and is completely covered by the epiblast *Ep.* The Hypoblast is also beginning to show signs of becoming hollow in the center, and a true archenteron has probably been defined, but as yet there is no communication with the outside. It will also be noticed that the hypoblast, as a whole, has been pushed farther up relatively than in Fig. 10, and that it is in close contact with the epiblast at *M* and *A*. Sin-Singularly enough, the first evidence of a mouth appears as a depression in the epiblast at a point nearly opposite *S*; the depression *M* slowly deepens and finally breaks through, and is brought into communication with the archenteric cavity when not long after the vent breaks through at *A*, when the larval stomach and intestine are complete. By this time the velum *V* is developed, enabling the embryo to swim about by means of the rapid lashing movement of the long lash like filaments arranged in a circle between the shell and the mouth.

In a general way, the segmentation of the egg of the clam appears to resemble, in its early stages, at least, the same process in *Anodonta*, as described by Flemming.* The conclusion that the clam is exactly parallel to Anodonta in its development is not, however, warranted for this reason, and to clear up the questions raised here, we must await the results of another season's work.

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*Studien in der Entwickelungsgeschichte der Najaden. Sitzb. de k. Akad. der Wissensch., LXXI. Bd., I and II Hft., p. 81. Vienna, 1875.

APPENDIX B.

OYSTER

AND

FISH LAWS.

OYSTERS.

PUBLIC GENERAL LAWS.

Chapter 198, *Laws of* 1880, *repeals Chapter* 181, *Laws* 1874, (*Sections* 3 *and* 5 *of which were repealed and re-enacted by Chapter* 380, *Laws* 1876,) *and enacts the following in lieu thereof, to be Article* 71, *Code of Public General Laws, title* " *Oysters.*"

SECTION 2. *Be it enacted*, That no steamer shall be used or employed in catching oysters in the waters of this State, with scoop, dredge or similar instrument, and no other boat shall be used in catching oysters with scoop, dredge or similar instrument, without first having been licensed as hereinafter provided.

Must obtain license.

SEC. 3. *And be it enacted*, That the Comptroller of the Treasury shall, upon application of any person who has been a resident of this State for twelve consecutive months next preceding such application, and to no other person, issue a license to such resident to employ such boat in catching oysters with scoop, dredge or similar instrument, within the waters of Chesapeake Bay and in Eastern Bay, outside of a line drawn from the southwest corner of Second Kent Point to Wade's Point; provided, that nothing herein contained shall authorize the catching of oysters with scoop, dredge or similar instrument, on any oyster bar within one and a half miles of Tolley's Point, Sandy Point, Hackett's Point, Thomas' Point, Holland Island Bar, Three Sisters, Swan Point Bar, Poplar Island, one-quarter of a mile west of, and between the island and the main land, nor within a half mile of Plum Point, and to buy and sell oysters in this State, which license shall hold

Who to receive license.

Prohibition specified.

good for one year, but shall only authorize the catching of oysters between the fifteenth day of October and the first day of April, but it shall be lawful for the owner of any such boat licensed, whenever said owner shall sell and convey by bill of sale for a bona fide consideration, said boat, unto any person who has been a resident of the State of Maryland for at least one year, to transfer the said license to said vendee with said boat, which license, when transferred, shall entitle said vendee with said boat to the same privileges for catching oysters in the waters of this State, that the original vendor or assignor had before said assignment; provided, the said vendee and assignee shall appear before the Comptroller of the Treasury and make oath before him to all the facts, matters, things and prerequisites required of said original vendor or assignor before taking out such licenses, upon which said license the said Comptroller shall certify the fact of said vendee or assignee have taken said oath, and for which said assignee or vendee shall pay the sum of five dollars, to be paid to the State of Maryland.

Right to transfer license.

Make oath of facts.

Sec. 4. *And be it enacted*, That the owner of such boat shall make oath before the Comptroller or his clerk, or if the owner be a resident of Baltimore city, he shall make oath before the Clerk of the Court of Common Pleas, or if a resident of a county, shall make oath before the Clerk of the Circuit Court of said county, that he is the bona fide owner of such boat to be described in the license; that he has been resident of the State for the time before mentioned; that there is no lien on said boat by a non-resident; that the said boat is not held with an intention to violate the provisions of this law, such applicant shall produce before the Comptroller, at the time of such application, the certificate of the taking of such oath, the Custom-House enrollment or license of such boat; and if such boat is under Custom-House tonnage, the owner shall swear as to her ton-

Must be bona fide owner.

nage; the master of such boat shall make oath before the Comptroller or his clerk; or if a resident of Baltimore city, before the clerk of the Court of Common Pleas, or the clerk of the county whereof he may reside, that he has been a resident of the State of Maryland for twelve months next preceding the time of taking such oath.

Swear to tonnage.

SEC. 5. *And be it enacted*, That before granting such license, the Comptroller shall receive for it from the applicant, at the rate of three dollars per ton for every ton the boat may measure; the license shall be exhibited whenever called for by any officer of the State of Maryland.

License to be exhibited.

SEC. 6. *And be it enacted*, That any person who shall violate any of the provisions of the preceding sections shall be deemed guilty of a misdemeanor, and upon indictment and conviction in any Circuit Court, or before any Justice of the Peace of this State, before whom such case is tried, shall be fined not less than fifty dollars nor more than two hundred dollars, or sentenced to the House of Correction for a term not less than three months nor more than three years; and the boat or vessel used in said violation, together with the papers, furniture and tackle on board of said boat or vessel at the time of the said violation, shall pay a penalty of not less than fifty dollars nor more than three hundred dollars for each and every violation of the preceding section.

Penalty for violation.

SEC. 7. *And be it enacted*, That upon information given under oath to any Judge of the Circuit Court or Justice of the Peace, of any violation of any of the provisions of this act, he shall issue his warrant to the sheriff or any constable, requiring any of them to whom it may be directed, to summon a posse comitatus if necessary, and proceed forthwith to arrest the party or parties alleged to have been en-

Issue warrant.

gaged in the violation of this act, and to seize and to take possession of any boat, canoe or vessel, together with all her tackle and apparel on board of the same, and deliver the same to the Judge of the Circuit Court or a Justice of the Peace of this State, to be dealt with according to the provisions of this act.

Penalty for resistance.

SEC. 8. *And be it enacted*, That any person or persons who shall resist any officer authorized under this act to make arrests, shall be deemed guilty of a misdemeanor, and upon indictment and conviction thereof in any court having jurisdiction, shall be imprisoned in the House of Correction for not less than three months nor more than three years, in the discretion of the court; the parties tried and acquitted under this act shall have the cost of such trial paid by the Comptroller of the State out of the funds created by this act.

Who to arrest.

SEC. 9. *And be it enacted*, That it shall be the duty of the sheriff, constable or officers of the State Fishery Force, to arrest any person or persons, and to seize any canoe, boat or vessel found violating any of the provisions of this act, and bring the offender or offenders before a Judge of the Court having criminal jurisdiction, or a Justice of the Peace most convenient or accessible, to be dealt with as herein provided.

Give immediate hearing.

SEC. 10. *And be it enacted*, That the Judge or Justice of the Peace, before whom any person or persons may be brought, charged under oath with violating any of the provisions of this act, the said Judge or Justice of the Peace shall either give the case an immediate hearing, or at the instance of the party or parties charged with a violation of this act, shall appoint some early day within the next ten days thereafter, to hear the case, the party or parties charged giving such good and sufficient bail as said Judge or Justice shall require, for his or their attendance, and on conviction of the offender or offenders, the said Judge or Justice of the Peace shall impose a fine upon the offender or offenders of not less than fifty dollars nor more than two hundred dollars, or imprisonment in the House of Correction for not less than three months, nor more than three years, and the boat or vessel used in such violation, together with all the apparel and tackle on board, at the time of said violation, shall be held until said fine and costs are paid; provided, that if said fine shall not be paid within twenty days thereafter, it shall be the duty of the said Judge or Justice of the Peace to decree forfeiture of the said boat or vessel, together with all the apparel and tackle on board, and he is hereby authorized to order any sheriff or constable to sell said boat or vessel, together with all the apparel and tackle on board, to the highest bidder, for cash, after giving at least twenty days' notice of the time and place of said sale, and the proceeds of said sale shall go to the payment of the fine and costs of such prosecution, and the balance, if any, shall be paid to the owner of said boat or vessel; provided, the said owner shall have the right of an appeal to the Circuit Court.

Decree forfeiture.

SEC. 11. *And be it enacted*, That any boat owned wholly or in part by any non-resident, used in catching oysters in this State with scoop, dredge or similar instrument, shall be condemned by order of any Judge of the Circuit Court nearest the place of her capture, or if captured in Baltimore, by order of the Judge of the City Court, and shall be sold by the sheriff of the county where condemned, or if condemned in Baltimore city, by the sheriff of said city, to the highest bidder, for cash, after twenty days notice of the time and place of sale, such notice to be published at least three times in a newspaper having the largest circulation, printed in Baltimore city or in the county where condemned; one-fourth of the proceeds of such sale shall be paid to the party

To be sold to highest bidder.

making the capture, (except the officers of the State Fishery Force,) and the balance shall be paid into the Treasury of the State to be credited to the Oyster Fund.

Fines to be paid to clerk.

SEC. 12. *And be it enacted*, The fines accruing under this act shall be paid by the sheriff, constable or officers of the State Fishery Force, collecting the same, within ten days, to the clerk of the county or city where such fine may accrue, and such clerk shall account for the same in his next quarterly term to the Comptroller of the Treasury, to be placed to the credit of the Oyster Fund.

Penalty for violation.

SEC. 13. *And be it enacted*, That it shall be unlawful, without authority from the owner, for any person or persons to take or catch planted or bedded oysters; any person or persons violating the provisions of this section shall be deemed guilty of a misdemeanor, and on conviction in the Circuit Court of the county wherein the oysters were bedded, shall be fined not less than five dollars nor more than fifty dollars, or be sentenced to the House of Correction for a term not less than three months nor more than three years, at the discretion of the Judge or Justice trying the same.

When unlawful.

Penalty for violation.

SEC. 14. *And be it enacted*, That it shall be unlawful for any person or persons to take or catch oysters, except for private use, to the amount of five bushels per day, or for sale of the same to any citizen or citizens of the neighborhood, and to them only for the purpose of being consumed where sold, or for the purpose of replanting or bedding in the waters of the counties wherein they are caught, or for sale to the citizens of the county wherein they are caught, and to them only for the purpose of replanting or bedding in the waters of said counties, between the fifteenth day of April and the first day of September, in each and every year; any person violating this section shall be deemed guilty of a misdemeanor, and fined by a Justice of the Peace of the county wherein the offence was committed, not less than fifty dollars, nor more than two hundred dollars, or imprisonment in the House of Correction for not less than three months nor more than three years.

SEC. 15. *And be it enacted*, That it shall be unlawful for any person or persons to take or catch oysters on Sunday or at night, or to carry oysters in the shell outside the State, between the first day of April and the first day of September; and any person or persons violating this section shall be fined a sum of not less than fifty dollars nor more than three hundred dollars, or sentenced to the House of Correction for a period of not less than three months nor more than three years, or forfeit the boat, vessel or canoe used in violation of this Act, at the discretion of the Judge or Justice of the Peace trying the same.

When unlawful.

SEC. 16. *And be it enacted*, That the Comptroller of the Treasury shall have painted in black figures on white canvas two sets of numbers, corresponding to the license to catch oysters with scoop, scrape, dredge or any similar instrument, each figure shall be twenty-two inches in length and of proportionate width, and the figures at least six inches apart, and he shall give to each person taking out such license two numbers thereof, one of which shall be firmly sewed upon the starboard side, and in the middle of that part of the mainsail which is above the close reef, and the other number on the port side, and in the middle part of the jib, which is above the bonnet and reef; these numbers shall be placed in an upright position, and worn at all times during the dredging season, and shall not be concealed or defaced, and no other number shall be exposed to view or used than that which is furnished by the Comptroller; any person or persons who shall violate

Numbers to correspond with license.

Numbers — where placed.

the provisions of this section, shall be deemed guilty of a misdemeanor, and upon conviction in any Circuit Court in this State, or before a Justice of the Peace, shall be fined not less than fifty dollars, nor more than one hundred dollars, or imprisoned in the House of Correction, for a period of not less than three months, nor more than two years; provided, the Court or Justice of the Peace trying the same, shall be convinced that the provisions of this section have been intentionally violated.

Must obtain license.

Boundaries to be strictly construed.

Sec. 17. *And be it enacted*, That any resident of this State, desiring to use any canoe or other boat, in catching or taking oysters with rakes or tongs for sale, in any of the waters of this State, shall first obtain, by application to the Clerk of the Circuit Court of the county wherein he may reside, a license therefor, and such license shall have effect from the first day of June, in the year in which they may have been obtained, to the first day of June next succeeding; provided, that such license shall not authorize the use of said canoe or boat in taking or catching oysters in any creek, cove, river, inlet, bay or sound within the limits of any county, other than that wherein the license shall have been granted, and that the boundaries of counties bordering on navigable waters, shall be strictly construed so as not to permit the residents of either county to take or catch oysters beyond the middle of the dividing channel; provided, that nothing in this section shall be so construed as to prevent the citizens of St. Mary's and Calvert counties from using the waters of the Patuxent river in common, or the citizens of Queen Anne's and Kent counties from using the waters of Chester river in common, or the citizens of Dorchester and Wicomico counties from using the waters of the Nanticoke river in common, or the citizens of Queen Anne's and Talbot counties from using the waters of Wye river and the mouth thereof in common, or citizens of Dorchester or Talbot counties from using the waters of the Choptank river in common.

State name and residence.

SEC. 18. *And be it enacted*, That each and every license to take or catch oysters for sale, with rakes or tongs, shall state the name and residence of the person to whom the same is to be granted, the number, together with the length to be obtained by top or over all, measurement of the canoe or boat licensed, the county in which the same is to be used and the period at which said license will expire, and every applicant for such license shall pay to the Clerk of the Court where such license may be granted, and before the issuing and delivery of the same, according to the following rates, viz: For any boat measuring in length twenty feet or less, the sum of two dollars; measuring from twenty to twenty-five feet, the sum of three dollars; measuring from twenty-five to thirty feet, the sum of four dollars; and all over thirty feet, including sloops under Custom House tonnage, the sum of five dollars each, and all oysters taken with rakes or tongs shall be culled upon the natural beds where they are taken; the amount received from tonging license to be paid by the Clerk to the School Commissioners, for the public schools in the respective counties where such license is issued; provided, the sum received from white tongers shall go to white schools, and the sum from colored tongers shall go to the colored schools.

Rates to be charged.

Make oath or affirmation.

SEC. 19. *And be it enacted*, That every applicant for license to use any canoe or other boat in taking or catching oysters with rakes or tongs, shall be required to make oath or affirmation before the clerk authorized to issue the same, or some Justice of the Peace, on whose certificate of the taking of such oath or affirmation the clerk shall issue said license; that the facts set forth in said license are strictly true; that he has been a bona fide resident of the county for the twelve months next preceding his application for said license; that he desires and intends to use said canoe or boat only in the county in which he resides, or in the waters used in common, as herein provided in this act; that he will not allow the same to be used for taking oysters by non-residents of the county; that he will comply with and obey all the laws of this State, regulating the taking or catching of oysters; and every person to whom such license shall have been granted, shall paint the number of his canoe or boat on the outside thereof, near the gunwale, in black figures, and not less than three inches in length, and of proportionate width, in a white ground, and no number, other than that in the said license, shall be exposed to view on said canoe or boat; and any person failing to comply with this provision before using said boat or canoe for the purpose aforesaid, shall, on conviction thereof before a Justice of the Peace, be fined not less than five dollars, nor more than ten dollars, and any person who may refuse to pay said fine, shall be committed to the county jail for the period of thirty days, or until said fine be paid.

Paint number of boat.

Sec. 20. *And be it enacted*, That the Comptroller of the Treasury shall cause to be printed and delivered to the Clerks of the Circuit Courts of the several counties, the requisite number of such blank licenses, and take receipts for the same, as for orther licenses furnished; and the said clerks shall, on the first Monday of March and December, in each year, return to the Comptroller a list and account of such licenses, issued by them, and no licenses to take or catch oysters with rakes or tongs shall be issued to any boat or vessel which is licensed to take or catch oysters with scoop, drag, dredge or any similar instrument.

Blank licenses to be furnished clerks.

Sec. 21. *And be it enacted*, That if any person shall use any canoe or boat, not licensed as required by the preceding section of this article, in taking or catching oysters with rakes or tongs, except for private use, he shall, upon conviction thereof before a Justice of the Peace for the county wherein the offence has been committed, be find not less than twenty nor more than one hundred dollars; and in case of refusal to pay the said fine, said party shall be confined in the House of Correction for a period not less than three months, nor more than three years.

Fine for violation.

SEC. 22. *And be it enacted*, That all moneys arising from fines, penalties or forfeitures imposed under this article, shall, upon warrant of the Comptroller, be paid into the Treasury and placed to the credit of the Oyster Fund; and the Comptroller is hereby required to state in his annual report, particularly, the receipts and expenditures on account of said fund, the balance standing to the credit of the State at the time of making such report.

Fines to be paid into treasury.

SEC. 23. *And be it enacted*, That the owner or owners of any land bordering on any of the navigable waters of this State, the lines of which extend into and are covered by said waters, shall have the exclusive privilege of using the same for protecting, sewing, bedding or depositing oysters or other shell fish, within the lines of their own land; and any owner or owners of land lying and bordering upon any of the waters of this State shall have power to locate and appropriate in any of the waters adjoining his, her, or their lands, five acres, for the purpose of protecting, preserving, depositing, bedding or sowing oysters or other shell fish; and that any other citizen of the State shall have power to locate and appropriate five acres in any waters in said State not located or appropriated; provided, thirty days notice in writing shall be given the owner or owners, occupant or occupants of land bordering on said water proposed to be located; that the owner or owners, occupant or occupants,

Have exclusive privilege.

Power to locate five acres.

may have priority of claim, and if they shall fail to locate or appropriate the water mentiontioned in said notice within thirty days after receiving the same, then it shall be open and free to any one under the provisions of this section; provided, also, that the said location or appropriation shall be described by stakes, bushes or other proper and visible metes and bounds, which description shall be reduced to writing under the oath of some competent surveyor, and recorded at the expense of the party locating or appropriating the same in the office of the Clerk of the Circuit Court in the county wherein such land may be located; and provided, also, that such location and appropriation shall not injure, obstruct or impede the free navigation of said waters; and provided, that no natural bar or bed of oysters shall be so located or appropriated, and that six months peaceful possession of all locations of oyster grounds under the laws of this State shall constitute a good and sufficient title thereto; but should any one, within the six months herein provided, be charged with locating or appropriating any natural bed or bar hereinbefore prohibited, the question may be at once submitted by any person interested, to the judge of the circuit court in the county where such questions shall arise, who, after having given notice to the parties interested, proceed to hear the testimony and decide the case, and if decision be in favor of the party locating said five acres, said decision shall be recorded with the original record of said five acres, and shall in all cases be conclusive evidence of title thereto.

Describe by stakes.

Hear testimony.

Sec. 24. *And be it enacted*, That if any creek, cove or inlet, not exceeding one hundred yards at low water in breadth at its mouth, make into the lands, or that if any creek, cove or inlet of greater width than one hundred yards at low water mark, make into the lands, the owner or owners, or other lawful occupant or occupants, shall have the exclusive right to to use such creek, cove or inlet when the mouth of said creek, cove or inlet is one hundred yards or less in width, and when the said creek, cove or inlet is more than one hundred yards in width at its mouth at low water, the said owner or owners, or other lawful occupant or occupants, shall have exclusive right to use such creek, cove or inlet, so soon as said creek, cove or inlet in making into said land or lands, shall become one hundred yards in width at low water, for preserving, depositing, bedding or sowing oysters or other shell fish, although such cove, creek or inlet may not be included in the lines of any patent.

Exclusive right.

SEC. 25. *And be it enacted*, That the Board of Public Works is empowered and directed, to purchase for each of the guard boats, such arms and ammunition as may be necessary to make them efficient.

Purchase arms.

SEC. 26. *Be it enacted*, That for the more efficient working of the State Fishery Force, the waters of this State shall be divided into seven districts, of which the waters of Kent county and Queen Anne's, shall be the first; the waters of Queen Anne's and Talbot, shall be the second; the waters of Dorchester and Talbot, the third; the waters of Wicomico, the fourth; the waters of Somerset county, the fifth; the waters of Anne Arundel county, the sixth; the waters of St. Mary's, Charles and Calvert, the seventh; each of the said districts shall be guarded by one sailing vessel, except the third and seventh, which shall be guarded by two; and it shall be the duty of the deputy commander of the first district, to guard the waters of Chester river, belonging to Queen Anne's county and the waters of Kent county, including Swan Point Bar; and the duty of the commander of the second district, to guard the watrs of Eastern Bay and its tributaries, and the waters of Talbot county, as far down as Black

Divide into districts.

How guarded.

Walnut Point; and it shall be the duty of one of the deputy commanders of the third district, to guard the waters of Choptank river and its tributaries, which lay in Talbot county; and the duty of the commander of Wicomico county boat, to guard the waters of Wicomico county, and the line between Somerset and Wicomico county; and the remaining commanders to guard their respective districts; provided, that the Board of Public Works or the commander of the Fishery Force, are hereby authorized and empowered to order the deputy commanders to do duty in any of the waters in this State when, in the judgment of either, they may deem it necessary.

Perform duties in other waters.

Power to appoint.

SEC. 27. *And be it enacted*, That the Board of Public Works shall have power to appoint a suitable person to command said force, to appoint the deputy commanders for their respective districts from persons of the counties whose waters comprise the different districts, who shall be commissioned by the Governor, and the said commander and deputy commanders shall have power to appoint their subordinates, and select their crews: and the term of office of said commander and deputy commanders shall be for two years, unless sooner removed for incompetency or neglect of duty, and if any of said officers shall fail in the discharge of his duty by reason of collusion with parties interested in violating any of the provisions of this act, he shall be guilty of a misdemeanor, and on indictment and conviction in a court of law, shall be fined or imprisoned at the discretion of the court.

Power to remove.

SEC. 28. *And be it enacted*, That the Board of Public Works shall have the power to remove any officer of said force for neglect of duty or incompetency, and any officer commanding in said force, shall have the power to remove any subordinate under his command, and appoint a person to fill the vacancy whenever the interest of said service may, in his judgment, require him to do so.

SEC. 29. *And be it enacted*, That the Board of Public Works shall have power to keep the steamer and said vessels in good order, and the Treasurer of the State, upon requisition of the said Board, and the warrant of the Comptroller, is hereby required and directed to pay the sum or sums necessary to carry out the provisions of this act.

To pay sums necessary.

SEC. 30. *And be it enacted*, That the commanding officer who shall have charge of the steamer, may be selected from the State at large, but the deputy commanders shall be selected from the districts in which they are to serve.

How selected.

SEC. 31. *And be it enacted*, That the commanding officer be, and he is hereby, required to keep his vessel constantly on duty when circumstances will permit; and that every locality where a violation of the law is likely to occur, shall be visited as often as the duties of the force and condition of the vessel will allow, and that every three months a report shall be made to the Board of Public Works of all official action taken under the law, and of all money received for license issued to parties engaged in carrying oysters taken in this State, which on warrant of the Comptroller shall be paid into the Treasury.

Keep on constant duty.

SEC. 32. *And be it enacted*, That it shall be the duty of the deputy commanders to confine themselves ordinarily to their several districts; but it shall also be their duty to enforce any of the provisions of this act in any waters adjacent to their districts, when a violation of the same shall come to their knowledge, and that they shall report quarterly to the Comptroller the amount of moneys received for licenses issued to persons engaged in carrying oysters, taken in this State, and on receiving his warrant shall pay the same into the Treasury.

Confine to districts.

SEC. 33. *And be it enacted*, That the commanding officer and the deputy commanders of said force, shall, before entering upon the discharge of their duties, take, before one of the Judges of the Circuit Court, the oath prescribed by the Constitution, and the commanding officer of said force shall enter into bond to the State of Maryland in the sum of ten thousand dollars, and each deputy commander in the sum of three thousand dollars, to be approved by said judges, for the faithful performance of their duties as prescribed in this act; the said bond or bonds to be filed with the Comptroller.

Take oath.

Enter into bond.

Salary of commander.

SEC. 34. *And be it enacted*, That the salary of the commanding officer in charge of steamer shall be one thousand five hundred dollars per annum, and he shall have power to appoint one officer, at a salary of seven hundred dollars per annum; one engineer at eight hundred dollars per annum, and one officer at six hundred dollars per annum, two seamen at twenty-five dollars per month; two seamen at twenty dollars per month; one fireman at thirty dollars per month; one fireman at twenty dollars per month; one steward at twenty dollars per month, and one cook at twenty-five dollars per month; and each deputy commander shall receive a salary of eight hundred dollars per annum; he shall have power to appoint one officer at a salary of five hundred and fifty dollars per annum, and three seamen at a salary of thirty dollars per month each, to be selected from the districts in which they are to serve.

Salary of appointees.

SEC. 35. *And be it enacted*, That the officers and crew of the steamer aforesaid, shall each receive one ration per day, of the quality and quantity, such as is allowed by law to the officers and crew of the Revenue Marine of the United States, but no rations shall be allowed to officers or crews of the sailing vessels.

Rations.

SEC. 36. *And be it enacted*, That the officers and crews aforesaid, shall be paid monthly by the Treasurer, upon warrant of the Comptroller and the certificate of the commanding officers, that their duties have been performed, as required by law.

Monthly payments.

SEC. 37. *And be it enacted*, That all oysters in the shell disposed of in the State of Maryland, shall be measured in a sealed measure of any capacity, from half a bushel to three bushels, that may be agreed upon between the seller and purchaser; provided, that the said measure or measures shall contain in quantity for each bushel thereof, according to the following dimensions: That is to say, sixteen and a half inches across, from inside to inside at the bottom, eighteen inches across from inside to inside at the top, and twenty-one inches diagonal from the inside chime to the top, and the same shall be even or struck measure.

How measured

Dimensions of measure.

SEC. 38. *And be it enacted*, That it shall be the duty of the purchaser or seller to have and use said measure or measures, duly inspected and sealed by the proper officers, and that no other measure shall be used under a forfeit of fifty dollars for each and every offence, to be recovered before any Justice of the Peace, by action of debt, in the name of the State of Maryland, one-half to go to the informer, the other half to be paid to the Comptroller, to be placed to the credit of the oyster fund.

Inspect and seal measure.

SEC. 39. *And be it enacted*, That if any boat or vessel shall be seen sailing over any of the waters of this State, which are exempted from dredging by law, in the same manner in which they sail to take or catch oysters with scoop, scrape, drag, dredge or similar instrument, the said boat or vessel shall be pursued by any officer or officers authorized by this act to make arrests, and if said boat or vessel apprehended by said officer, shall be found to have on board any wet oysters on deck and properly equipped

Officers to pursue.

for taking or catching oysters with scoop, scrape, drag or dredge or similar instrument, it shall be prima facie evidence that the said boat or vessel has been used in violation of this act, and it shall be the duty of the officer to arrest the person in command of said boat or vessel, and seize the said boat or vessel, together with all her equipments, and bring the same before a Judge or Justice of the Peace most accessable, to be dealt with according to law; provided, that nothing in this act shall be construed to prohibit vessels from seeking harbor in any waters of this State.

Officere must arrest.

Where culled.

SEC. 40. *And be it enacted*, That all oysters taken from any of the waters of this State, shall be culled upon their natural bed or bar; any person or persons violating the provisions of this section, shall be deemed guilty of a misdemeanor, and upon trial and conviction before any Judge or Justice of the Peace of this State, shall be fined not less than fifty nor more than three hundred dollars, or sentenced to the House of Correction for a term not less than three months, nor more than three years, or forfeit the canoe or vessel used in said violation.

Fine for violation.

Right of appeal.

SEC. 41. *And be it enacted*, That any person or persons convicted under any of the provisions of this act, shall, in all cases, have the right of an appeal.

How construed.

SEC. 42. *And be it enacted*, That nothing in this act shall be construed so as to apply to Worcester county.

Arrest for violation.

SEC. 43. *And be it enacted*, That it shall be the duty of the commander of the steamer to diligently watch and guard and to arrest all persons dredging, tonging or scooping without license, and the commanders of the sailing vessels shall likewise guard and arrest all persons for any violation of the law in this respect in their several districts; any violation of duty in this respect shall be deemed a sufficient cause of removal.

SEC. 44. *And be it enacted,* That nothing contained in this act shall be construed to effect any prosecutions for the violation of the existing law now pending in this State.

How construed.

SEC. 45. *And be it enacted,* That this act shall take effect from the date of its passage.

Effective.

PUBLIC LOCAL LAWS.

DORCHESTER COUNTY.

Capter 299, *Laws* 1880, *amends Chapter* 325, *Laws* 1878, *which repealed Chapter* 214, *Laws of* 1874, *by adding an additional section.*

SECTION 13. *And be it enacted,* That the captains of every licensed canoe, boat or vessel under this act, shall be a police officer for making special arrests, and the School Commissioners of Dorchester county are hereby authorized to allow any such captain one-half the fine that is paid to the said board for arrests made by him of non-residents taking or catching oysters in the waters of said county.

Captains to arrest.

POTOMAC RIVER.

Chapter 36, *Laws* 1880, *regulates the catching of Oysters in the Waters of the Potomac River.*

SECTION 1. *Be it enacted by the General Assembly of Maryland,* That no boat or vessel propelled by steam shall be used in catching oysters in the waters of the Potomac River, and no other boat shall be used in catching oysters with scoop, dredge, drag or similar implement, in the waters of said river, without first having been licensed as hereinafter provided.

Not to catch oysters without license.

SEC. 2. *And be it enacted,* That the Comptroller of the Treasury shall, upon the application of any person who has been a resident-citizen of this State for twelve months next preceding such application, and who is the bona fide owner of the boat or vessel sought to be licensed, and to no other person, issue a license to use such boat or vessel in catching oysters with scoop, dredge, drag or similar implement within such of the waters of the Potomac River as are not prohibited by the provisions of this act, which license shall hold good for one year, but shall only authorize the catching of oysters between the fifteenth day of October and the first day of April; but it shall be lawful for the licensed owner of any such boat, whenever such owner shall sell and convey by bill of sale for a bona fide consideration said boat to any person who has been a resident of this State for the twelve consecutive months next preceding such sale, to transfer the said license to said vendee with said boat, which license, when so transferred, shall entitle said vendee with said boat to the same privileges for catching oysters in the waters of the Potomac River that the vendor had before such sale, provided that said vendee shall appear before the Comptroller of the Treasury and make oath before him to all the facts, matters, things and prerequisites required of said original vendor before taking out such license, upon which said license said Comptroller shall certify the fact of said vendee having taken said oath, and for which the said vendee shall pay the sum of five dollars, to be paid to the State of Maryland.

Issue license.

May transfer license.

Certify to fact of oath.

Sec. 3. *And be it enacted*, That the owner of such boat shall make oath before the Comptroller or his clerk that he is the bona fide owner of such boat to be described in the license: that he has been a resident-citizen of the State for the time beforementioned; that there is no lien on said boat held by a non-resident, and that said boat shall not be used in violating the provisions of this act; such applicant shall exhibit to the Comptroller at the time of such applica-

Not to violate the provisions of this act.

tion the Custom House enrollment or license of such boat, and if such boat is under Custom House tonnage shall swear to her tonnage.

License to be exhibited.

SEC. 4. *And be it enacted*, That before granting such license the Comptroller shall receive for it from such applicant the sum of three dollars per ton for every ton the boat may measure; said license shall be exhibited whenever called for by any officer of the State Fishery force or any person having a right under the provision of this act to make arrests and seizures for violating any of its provisions.

Depth of waters.

SEC. 5. *And be it enacted*, That no person or boat licensed under the provisions of this act shall take or catch, or be used in taking or catching oysters with scoop, dredge, drag or similar implement, in any waters of the Potomac River of less than twelve feet in depth, nor in any of the waters of said river between the Maryland shore and straight lines as follows: From the most eastern point of the headland known as Posey's Bluff, to a buoy near the southern or south-eastern point or prong of Herron Island Bar, thence to Blackistone's Island Light House, thence to a buoy near the end of Cobb Point Bar.

Liable to arrest.

SEC. 6. *And be it enacted*, That if any person or persons having been licensed under this act to catch oysters with scoop, dredge, drag or similar implement, in the waters of the Potomac river, shall violate the provisions of the preceding sections, such person or persons shall be liable to arrest, and the boats, vessels and equipments used shall be seized, and upon proof of such violation before a Justice of the Peace or a Judge of the Circuit Court for the county nearest the place of such violation, on arrest and seizure shall be fined not less than fifty dollars nor more than three hundred dollars; and said fines and all costs of prosecution shall be a lien on the boats, vessels and equipments, which, if said fine and costs of prosecution be not paid within ten days after judgment, or appeal be not taken as hereinafter provided, shall be sold at public sale to the highest bidder for cash, under such orders and notice as the Judge or Justice aforesaid may prescribe; if said arrest and seizure be made by an officer of the State Fishery Force, said fine shall be paid into the Treasury of the State; but if made by any other person or persons having the right to arrest and seize, one-half of said fine shall be paid to the Clerk of the Circuit Court of the county in which the case has been tried, to be paid by said Clerk to the Comptroller of the State, and the other half shall be equally divided between the parties who made or assisted in making the arrest and seizure.

To be sold at public sale.

SEC. 7. *And be it enacted*, That any boat, vessels and equipments owned wholly or in part by any non-resident, used in catching oysters in the waters of the Potomac river with scoop, dredge, drag or similar implement, upon seizure and proof shall be condemned by any Judge of the Circuit Court or Justice of the Peace of the county nearest the place of her capture, and shall be sold by the Sheriff of the county where condemned, to the highest bidder for cash, after ten days' notice of the time and place of sale; one-half of the proceeds of sale, less half the costs of prosecution and sale, shall be paid to the parties who made the capture, except when the capture was made by the State Fishery Force, and the balance shall be paid into the Treasury of the State.

Shall be condemned.

SEC. 8. *And be it enacted*, That the Comptroller of the Treasury shall have painted in black figures, on white canvas, two sets of numbers corresponding to the license, to catch oysters with scoop, dredge, drag or similar implement; each figure shall be twenty-two inches long and of proportionate width, and the figures shall be at least six inches apart, and he shall give to each person taking out such

Printed numbers.

license two numbers thereof, one of which shall be firmly sewed upon the starboard side and in the middle of that side of the mainsail, which is above the close reef, and the other number on the port side and in the middle part of the jib, which is above the bonnet and reef. These numbers shall be placed in an upright position and be worn at all times during the dredging season, and shall not be concealed or defaced; and no other number shall be exposed to view or be used than that which is furnished by the Comptroller. Any captain or other person in charge who shall vilolate the provisions of this section shall, upon proof of such violation before a judge of the circuit court or justice of the peace of the county nearest which such violation occurred, be subject to a fine of not less than fifty dollars nor more than one hundred dollars, and such fine and the costs of prosecution shall be a lien upon such boat or vessel on which were violated the provisions of this section, and unless said fine and costs be paid within ten days or appeal be taken, such boat or vessel shall be sold at public sale to the higest bidder for cash, under such orders and notice as the judge or justice of the peace may prescribe; one-half of the fine to be paid to parties making the arrest and capture unless the arrest and capture be made by the State Fishery force, and the balance to the treasury of the State.

Subject to fine.

SEC. 9. *And be it enacted*, That any person who has been a resident-citizen for the twelve months next preceding his application of a county bordering on the Potomac River, desiring to use any canoe or other boat in catching oysters for sale, with rakes or tongs in any of the waters of the Potomac River, shall first obtain, by application to the clerk of the circuit court for the county wherein he resides, a license therefor, and such license shall have effect from the first day of June in the year in which it may have been issued to the first day

County license.

of June next succeeding; provided that such license shall not authorize the use of said canoe or boat in taking or catching oysters in any creek, cove, inlet, bay or sound within the limits of any county other than that wherein the license shall have been issued.

State name and residence.

SEC. 10. *And be it enacted*, That each and every license to catch oysters, for sale, with tongs or rakes in the waters of the Potomac River, shall state the name and residence of the person to whom the same is granted, the number and length of the canoe or boat by top or over-all measurement, the county in which the same is to be used, and the period at which said license will expire; said license shall also state that the holder thereof is, by virtue of said license, authorized and required to make, or assist in making, arrest of any persons, and seize any boats, vessels and equipments engaged in violating the provisions of this act. For such license the applicant shall pay to the Clerk of the Circuit Court issuing the same as follows: For a boat or canoe measuring in length twenty feet or less the sum of two dollars; for a boat or canoe twenty to twenty-five feet in length the sum of three dollars; for a boat or canoe twenty-five to thirty feet in length the sum of four dollars; for a boat or canoe over thirty feet in length the sum of five dollars; and for sloops under Custom House measurement the sum of six dollars. And all oysters taken shall be culled upon the natural beds where they are taken. The amount received from tonging licenses shall be paid by the Clerk to the School Commissioners for the Public Schools of the respective counties where such licenses are issued, provided the sum received from white tongers shall be applied to the white school fund, and the sum from the colored tongers to the colored school fund. No license to tongers under the provisions of this act shall authorize the catching of oysters for sale during the months of April, May, June, July and August. And any person or persons violating the

Amount to be paid.

provisions of this section shall be subject to like penalties as are prescribed by the preceding sections of this act.

Sec. 11. *And be it enacted*, That every applicant for license under this act, to use any canoe or other boat, in catching oysters for sale, with rakes or tongs, shall be required to make oath or affirmation, before the clerk authorized to issue the same, or some Justice of the Peace of the county, on whose certificate of the taking such oath or affirmation the clerk shall issue such license; said oath or affirmation shall assert that he has been a resident-citizen of the county for the twelve months next preceding his application, the length of the boat or canoe to be used; that he is the bona fide owner of said boat or canoe; that he will not violate the provisions of this act; that he will arrest and seize, or assist in arresting and seizing all persons and boats, vessels and equipments engaged in violating the provisions of this act, so far as it may in his power to do so, and that he will not employ or permit any person to use his boat or canoe so licensed, on hire or shares, who has not been a bona fide resident citizen of the county for the twelve months next preceding such employment or permission to use, and that he will inform against and prosecute all persons who shall violate this or any other provision of this act. The penalty for violating any of the provisions of this section shall be not less than ten dollars, nor more than fifty dollars, to be recovered before a Justice of the Peace of the county, and said fine and costs of prosecution shall be a lien upon the boat and equipments of the offending party, which, unless paid within ten days after judgment, shall be sold under orders and notice prescribed by the Justice of the Peace for the payment of such fine and costs, one-half of such fine to be paid to the County School Commissioners, and the other half to the informer.

Required to make oath.

Penalty for violation.

SEC. 12. *And be it enacted*, That every licensed tonger, under the provisions of this act, shall paint the number of his boat or canoe on the outside thereof, near the gunwale, on each side of the bow, in black figures of not less than four inches in length, and of proportionate width, in a white ground, and no number other than that in the license shall be exposed to view on said canoe or boat; and any person failing to comply with this provision, before using said boat or canoe for the purpose aforesaid, shall be subject to a fine of not less than five dollars, and not more than ten dollars, to be recovered and paid over as provided in section eleven of this act.

Paint number of boat.

SEC. 13. *And be it enacted*, That if any person shall use any boat or canoe not licensed, as provided by this act, in catching oysters with rakes or tongs, for sale, he shall be subject to a fine of not less than ten dollars and not more than fifty dollars, to be a lien on the boat or canoe of the offender, to be recovered and paid over as provided in section eleven of this act; and if said fine be not paid he shall be imprisoned in the county jail for not less than two nor more than six months.

Fine and lien on boat.

SEC. 14. *And be it enacted*, That the Comptroller shall cause to be printed and delivered to the Clerks of the Circuit Courts of the counties bordering on the Potomac River, the requisite number of such blank licenses as are required by the provisions of this act, and said Clerks shall, on the first Mondays of March and December in each year, return to the Comptroller a list and account of such licenses issued by them; and no license to catch oysters with rakes or tongs shall be issued to any boat or vessel which is licensed to take oysters with scoop, dredge, drag, or any similar implement.

Deliver blank licenses.

SEC. 15. *And be it enacted*, That it shall be unlawful for any person to catch oysters on Sunday or at night with scoop, dredge, drag or

Unlawful.

similar implement, or by tongs; any person violating this section shall be fined a sum of not less than fifty dollars nor more than one hundred dollars, the fine and cost of prosecution to be a lien on the boat, vessel and equipments used in violating the provisions of this section, and the case shall be tried and disposed of, and the fine and costs collected and paid over as provided in section six of this act.

Fine for violation.

SEC. 16. *And be it enacted*, That it shall be the duty of the officers of the State Fishery Force, the sheriffs, constables and licensed tongsmen of the counties bordering on the Potomac River, to arrest any person found violating the provisions of this act, and to seize all boats, vessels and equipments engaged or used in such violation, and to bring the offenders before a Judge of the Circuit Court or a Justice of the Peace, most convenient or accessible, to be dealt with as by this act provided, and to hold such boats, vessels and equipments to be disposed of to secure the payment of such fines and costs of prosecution adjudged as hereinbefore provided by the preceding sections of this act.

Arrest for violating.

Seize boats, vessels, &c.

SEC. 17. *And be it enacted*, That upon information given on oath to any Judge or Justice of the Peace of any violation of any of the provisions of this act, he shall issue his warrant for the arrest of the offender and the seizure of the boat, vessel and equipments, which warrant shall be directed to the sheriff, constable or any licensed tongsman of the county wherein such warrant is issued, or to any officer of the State Fishery Force, and said persons, when arrested, shall be carried before said Judge or Justice of the Peace, and the boat, vessel and equipments shall be held to be dealt with according to the provisions of preceding sections of this act.

Issue warrants for arrest.

SEC. 18. *And be it enacted*, That if any person or persons shall resist any officer author-

Resisting officer.

ized by this act to make arrests of persons and seizure of boats, vessels and equipments, he or they shall be deemed guilty of a misdemeanor, and upon indictment and conviction in any Court having criminal jurisdiction shall be fined not less than one hundred dollars nor more than five hundred dollars, or imprisoned in the House of Correction for not less than three months nor more than one year, or both fine and imprisonment in the discretion of the Court; and the fine and costs of prosecution shall be a lien on any boat, vessel and equipments that may have been seized when such offenders were arrested, and such boat, vessel and equipment shall be disposed of to secure the payment of such costs and fine as the Judge of the Court may direct, according to the provisions of preceding sections in this act.

Fine and imprisonment.

SEC. 19. *And be it enacted*, That for all oysters bought and sold on the Potomac river the following shall be the standard bushel measure, viz.: A solid iron tub, measuring sixteen and one-half inches across the bottom from inside to inside, eighteen inches across the top from inside to inside, and twenty-one inches from the inside bottom, diagonally, to the inside top. This measure, even full, shall be a bushel; and any person using a larger measure shall be subject to a fine of ten dollars for each and every offence against the provisions of this section, to be recovered by proceedings before a Justice of the Peace, one-half to be paid to the informer and the other half to the Comptroller of the State.

Standard bushel measure.

SEC. 20. *And be it enacted*, That any person or persons feeling aggrieved by the judgment of any Justice of the peace in any trial for a violation of any provision of this act, may appeal to the Circuit Court for the county in which such case may have been tried; provided he or they give notice of such appeal within ten days after judgment, and shall within ten days after judgment pay the costs that have

May appeal.

Appeal bond.

accrued, and deliver to said Justice of the Peace an appeal bond with two or more sureties, to be approved by said Justice of the Peace, executed to the State of Maryland, in the penalty of double the amount of fine or penalty adjudged by said Justice of the Peace, said bond to be conditioned for the successful prosecution of said appeal.

Money—how placed.

SEC. 21. *And be it enacted*, That all money paid into the Treasury of the State, under the provsions of this act, shall be placed to the credit of the "Oyster Fund."

Not to apply.

SEC. 22. *And be it enacted*, That the provisions of this act shall not apply to the citizens of the State of Virginia.

How effective.

SEC. 23. *And be it enacted*, That this act shall take effect upon the approval of this act, and the passage of a similar act by the State of Virginia.

SOMERSET COUNTY.

Chapter 40, Laws 1880, protects Oysters in certain waters of Manokin River in Somerset County.

Unlawful to catch oysters.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall not be lawful for any person or persons to employ any canoe, boat, or vessel in catching or taking oysters, with scoop, scrape, drag or dredge or any similar instrument, in the waters of the Manokin River in Somerset county, east of a straight line from Hazard Point on the south side of said river to South Point on the southeast end of little Deal's Island.

Fined for violation.

SEC. 2. *And be it enacted*, That any person or persons violating any of the provisions of this act shall be fined in a sum not less than one hundred dollars nor more than two hundred dollars for each and every offence, and shall stand committed to the county jail until such fine and costs shall be fully paid and satisfied.

SEC. 3. *And be it enacted*, That on information under oath of any violation of the provisions of this act to any Justice of the Peace of Somerset county, the said justice shall forthwith issue his warrant to the sheriff or any constable of said county, requiring the officer to whom the said writ shall be directed to summon a posse comitatus, if necessary, and proceed at once to arrest the party or parties alleged to have been engaged in violation of this act, and forthwith bring the offender or offenders before some Justice of the Peace of Somerset county for a hearing, and the said Justice of the Peace shall either give the case an immediate hearing, or at the instance of the party or parties charged with a violation of this act, shall appoint some early day within the next seven days thereafter to hear the case, the party or parties charged giving such good and sufficient bail as said Justice shall require for his or their appearance at the trial, and on the conviction of the offender or offenders the said Justice shall fine such person or persons in a sum not less than one hundred dollars nor more than two hundred dollars and costs, in each and every case, and shall have power and authority to commit to the jail of said county such offender or offenders so convicted until such fine or fines, so imposed, and costs, shall be fully paid and satisfied, subject to an appeal in all cases to the Circuit Court for Somerset county, from any judgment or conviction which may be rendered by said Justice of the Peace.

Issue warrant.

May commit to jail.

SEC. 4. *And be it enacted*, That all fines accruing from the enforcement of this act shall be paid by the said Justice of the Peace to the secretary and treasurer of the school board of Somerset county, for the use of the public schools of said county.

Fines for use of public schools.

SEC. 5. *And be it enacted*, That this act shall take effect on and after the first day of May next.

Effective.

Chapter 445, *Laws* 1880, *protects Oysters in the waters of Pocomoke Sound in Somerset County.*

Unlawful to take oysters.

SECTION 1. *Be it enacted by the General Assembly of Maryland,* That it shall not be lawful for any person or persons to employ any canoe, boat or vessel in catching or taking oysters with scoop, scrape, drag or dredge, or any similar instrument, within the waters of Pocomoke sound, in Somerset county; nor shall any person or persons take or catch oysters for sale within said waters otherwise than with tongs, as restricted and regulated by the provisions of the General Oyster Law in force in this State.

Fine for violation.

SEC. 2. *And be it enacted,* That any person or persons violating the provisions of this act shall be fined in a sum not less than seventy-five dollars nor more than one hundred and fifty dollars for each and every offence, and shall stand committed to the county jail until such fine and the costs of suit are paid.

Issue warrant to sheriff.

SEC. 3. *And be it enacted,* That on information made under oath of any violation of the provisions of this act to any Justice of the Peace of Somerset county, he shall forthwith issue his warrant to the sheriff or any constable of said county, requiring said officer to proceed forthwith to arrest the party or parties alleged to have been engaged in the violation of this act, and bring him or them before said Justice at once for trial, and upon conviction shall be fined as required by section two of this act.

Give immediate hearing.

SEC. 4. *And be it enacted,* That the said Justice of the Peace shall either give the case an immediate hearing, or at the instance of the party or parties charged, shall appoint some early day, within the next five days thereafter, to hear the case, the party or parties charged giving such good and sufficient bail as said Justice shall require for his or their appearance;

and any party or parties feeling himself or themselves aggrieved by any conviction or judgment of said justice, shall have the right to appeal to the Circuit Court for Somerset county, which shall hear and determine the same as other cases on appeal.

SEC. 5. *And be it enacted*, That this act shall take effect upon the consent and ratification of the provisions of this act by the Legislature of the State of Virginia, as required by the compact between the States of Virginia and Maryland, in the year seventeen hundred and eighty-one.

How effective.

WORCESTER COUNTY.

Chapter 214, *Laws* 1880, *repeals Sections* 2 *and* 4 *of Chapter* 277, *Laws of* 1876, *relating to Oysters in the waters comprised within the limits of Worcester County, and enacts following substitute therefor :*

SECTION 2. *And be it enacted*, That the clerk of the Circuit Court for Worcester county may issue to any citizen of said county a license to take or catch oysters with rakes or tongs, from the waters of Synepuxent bay and its tributaries, until the first day of May next after the issuing of said license ; provided the applicant for said license shall satisfy said clerk by his own oath or other sufficient proof that he is a citizen of said county, and shall pay to said clerk the sum of one dollar, to be paid by said clerk to the County Commissioners of Worcester county, to be expended in the procuring of seed oysters to be planted in said bay as the commissioners aforesaid may direct ; but no person licensed as above, nor any other person, shall take or remove any oysters from the waters of said bay or its tributaries on any Sunday or in the night at any season, nor during the day from the first day of May to the first day of September, or any shells from the natural rocks at any time ; provided that nothing herein shall be construed to forbid any person

May issue license.

Satisfy by oath or proof.

How construed.

from taking or catching his or her own planted oysters at any time and with any kind of instrument, and any person violating any of the provisions of this section shall be guilty of a misdemeanor, and upon indictment and conviction therefor, shall be fined not less than ten nor more than fifty dollars for each offence, with costs.

Plant and lay down oysters.

SEC. 4 *And be it enacted*, That it shall be lawful for any citizen of Worcester county to stake off, not exceeding five acres in any one place in the waters of Synepuxent bay and its tributaries, except upon the natural rocks of said bay and its tributaries, and to plant and lay down oysters in said waters so staked off; and that no person except the ower of said planted or laid down oysters, or his employee, shall work upon or among said oysters, or in the waters so staked off; provided that, that portion of the said waters in which oysters are, or are intended to be planted or laid down not exceeding five acres in any one place, be kept plainly marked by means of bushes, stakes or buoys; and any person wilfully or maliciously removing said bushes, stakes or buoys, shall be liable to all the penalties of this section; and provided further, that nothing in this section shall affect the rights of owners of land to the exclusive use of any creek, cove or inlet within their said lands, not exceeding one hundred yards in width at its mouth; and any person violating the provisions of this section, or any of them, shall be liable to be sued as for damages to any other property, and also to indictment by the grand jury of said county, and upon conviction for any such violation shall be fined not less than ten dollars nor more than one hundred dollars, with costs, or imprisoned not less than one month nor more than six months in the county jail, or both, at the discretion of the court, for each offence; and in any prosecution for violating any of the provisions of this section it shall not be necessary in order to convict, to prove that the offender was

Marked by stakes, &c.

Fine for violation.

actually taking up oysters, but only that he was at work in the waters so staked off by bushes, stakes or buoys as aforesaid.

Effective.

SEC. 3 *And be it enacted*, That this act shall take effect from the date of its passage.

WICOMICO COUNTY.

Chapter 447, *Laws* 1880, *repeals Chapter* 241, *Laws* 1872, *protecting Oysters in the waters of Wicomico County and re-enacts the same with additional sections.*

Unlawful to take oysters.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall not be lawful for any person or persons to employ any canoe, boat or other vessel in catching or taking oysters with scoop, scrape, drag or dredge, or any similar instrument, within the waters of Wicomico county; nor shall any person or persons take or catch oysters within the waters of said county, otherwise than with tongs, as restricted and regulated by the provisions of the general oyster law in force in this State.

Bounds and time for taking.

SEC. 2. *And be it enacted*, That for the protection of young oysters in the waters of Wicomico county, it shall not be lawful for any person or persons to take or catch oysters above a straight line drawn from Sandy Island on the west side of the Nanticoke river, to Roaring Point on the east side of said river, between the first day of May and the first day of October, nor shall it be lawful for any person or persons, to convey beyond the limits of said county, any oysters from the first day of May to the first day of September in each and every year.

Penalty for violation.

SEC. 3. *And be it enacted*, That any person or persons violating the provisions of either the first or second sections of this act shall be fined in a sum not less than twenty-five dollars nor more than two hundred dollars, or forfeit the canoe, boat or vessel in his or their possession, together with the tackle and apparel, and all things on board at the time the offence may have been committed, and shall stand committed to jail until such fine shall be fully paid and satisfied.

Issue warrant to sheriff.

SEC. 4. *And be it enacted*, That on information, under oath, of any violation of the provisions of this act, to any Justice of the Peace of Wicomico county, he shall forthwith issue his warrant to the sheriff, or any constable, or military officer, requiring either of them to whom it may be directed to summon a posse comitatus, if necessary, and proceed forthwith to arrest the party or parties alleged to have been engaged in the violation of this act, and to seize and take possession of any canoe or canoes, boat or boats, vessel or vessels, together with all their tackle and apparel, and all things on board of the same belonging to said party or parties, or in their possession at the time of the offence or offences and used by him or them in violating this act.

Give early hearing.

SEC. 5. *And be it enacted*, That the sheriff, constable or military officer who shall make the arrest, shall forthwith bring the offender or offenders before some Justice of the Peace of Wicomico county, for a hearing, and the said Justice of the Peace shall either give the case an immediate hearing, or, at the instance of the party or parties charged with the violation of this act, shall appoint some early day, within the next five days thereafter, to hear the case, the party or parties charged with the violation or violations giving such good and sufficient bail as said Justice shall require for his or their attendance, and on conviction of the offender or offenders the said Justice shall fine such person or persons in a sum of not less than twenty-five dollars nor more than two hundred dollars in each and every offence, or shall decree a forfeiture of the canoe or canoes, boat or boats, vessel or vessels, together with all their tackle and apparel, and property found on board at the time of the seizure, and shall have power and authority to commit to the jail of said county such offender or offenders so convicted, until such fine or fines so imposed shall be fully paid and satisfied.

Power to commit.

SEC. 6. *And be it enacted*, That the Justice of the Peace before whom any such offender or offenders shall be tried and convicted, shall impose a fine of not less than twenty-five dollars nor more than two hundred dollars, or shall decree a forfeiture of the canoe or canoes, boat or boats, vessel or vessels used in such violation, together with all the apparel, tackle and property found on board, and he is hereby authorized to order any constable, sheriff or military officer, to sell the property so seized, on five days' notice, to the highest bidder for cash, subject to an appeal in all cases to the Circuit Court of Wicomico county; and after the payment of the expenses attending the arrest and prosecution in any such case, the officer making the arrest shall retain one-fourth of the balance himself, distribute one-fourth among the parties assisting in making the arrest and seizure, and pay over the remaining half to the State treasury, to be placed to the credit of the school fund for said county; provided if such seizure is made by the officers or crew of the Fishery Force of the State, then such portion as would accrue to them under the provisions of this act shall be paid into the treasury of the State and placed to the credit of the school fund for said county.

Impose fine.

Right of appeal.

SEC. 7. *And be it enacted*, That any person or persons on board of any canoe or canoes, boat or boats, vessel or vessels, engaged in violating any of the provisions of this act, and shall flee to avoid an arrest, the officer endeavoring to make such arrest shall seize such canoe or canoes, boat or boats, vessel or vessels used in such violation, and all property found on board, and the same proceeding thereupon shall be

Seize canoe or boat.

had as in all cases of seizure under other sections of this act.

Duty of State Fishery force.

SEC. 8. *And be it enacted*, That upon information given, under oath, of any violation of this act, the commander and deputy commanders of the State Fishery Force of this State, it shall be the duty of the said commander or deputy commanders to arrest the offender or offenders, and seize the boat or boats, canoe or canoes, vessel or vessels, together with all their tackle, apparel and property found on board, and deliver them over to the authorities of the said county, to be dealt with according to the provisions of this act; and the said commander and deputy commanders are hereby authorized to follow such alleged offender or offenders, and make snch arrest and seizure in any part of this State, as well as within the limits of said county.

Arrest with or without warrant.

SEC. 9. *And be it enacted*, That it shall be the duty of the commander and deputy commanders, with or without warrant, to arrest any person or persons, and to seize and to take into custody any canoe or canoes, boat or boats, vessel or vessels, with their apparel, tackle and property found on board of said boat, canoe or vessel, whenever such person or persons, canoe, boat or vessel shall be found violating, or being used in violating any of the provisions of this act, and bring the offender or offenders before a Justice of the Peace, to be dealt with as herein provided; and it shall be the duty of the Justice of the Peace before whom such person or persons shall have been taken by said officer, to take cognizance of the same and docket a case or cases in the name of the State against such person or persons, and the said boat, canoe or vessel; and the said justice shall proceed to try the same and render judgment as provided by this act.

SEC. 10. *Be it enacted*, That it shall not be lawful for any person or persons to take or catch oysters within the waters of Wicomico county, except citizens of said county; and any person or persons violating the provisions of this section shall be subject to like penalties as are prescribed in the preceding sections of this act.

Who are allowed.

SEC. 11. *Be it enacted*, That all owners and masters of canoes, boats or vessels licensed to take or catch oysters in the waters of Wicomico county, being white men, are hereby constituted officers for the purpose of arresting and taking before any Judge of any Circuit Court or Justice of the Peace who shall have jurisdiction therein, any person or persons who may be engaged in violating any of the provisions of this act, and of seizing any canoe, boat or vessel engaged therein; and all such owners and masters are hereby vested with power to summon the posse comitatus to aid in making such arrest and seizure.

Constituted officers.

SEC. 12. *Be it enacted*, That if any canoe or canoes, boat or boats, vessel or vessels, shall be used by any person or persons within the limits of Wicomico county, in the same manner or way in which they are used to take oysters with scoop, scrape, drag, dredge, or similar instrument, it shall be the duty of any officer, created by this act, to pursue such canoe or canoes, boat or boats, vessel or vessels, and if the said canoe or canoes, boat or boats, vessel or vessels, shall be found to have on board any scrapes, cranks, dredges, or any similar instruments, or any other equipments necessary to take oysters with scoop, scrape, dredge, or similar instrument, it shall be the duty of the said officer to seize the said canoe or canoes, boat or boats, vessel or vessels, and to arrest the person or persons found on board and bring them before some Justice of the Peace in said county, to be dealt with according to the provisions of this act; and the necessary appurte nances being on board of said canoe or canoes, boat or boats, vessel or vessels, to take oysters with scoop, drag, dredge, or similar instrument,

Duty of officer to pursue.

Evidence of violating.

shall be sufficient evidence that the said canoe or canoes, boat or boats, vessel or vessels, have been used in violating the provisions of this act.

Inconsistent acts repealed.

SEC. 13. *And be it enacted*, That chapter two hundred and forty-one, passed at the January session of the General Assembly, in the year eighteen hundred and seventy-two, entitled "An act to protect oysters within the waters of Wicomico county," and all other acts and parts of acts inconsistent with the provisions of this act be and the same are hereby repealed, and that this act shall take effect from the date of its passage.

Effective.

FISH AND FISHERIES.

PUBLIC GENERAL LAWS.

Chapter 260, *Laws* 1880, *repeals Chapter* 276, *Laws* 1878, *which repealed Chapter* 252, *Laws* 1876, *which repealed Chapter* 421, *Laws* 1874, *which repealed Section* 2, *Article* 41, *Public General Laws, title Fish and Fisheries, and re-enacts the same with substitutes and amendments, so as to read as follows:*

Seine hauling prohibited.

SECTION 1. No person shall from the tenth day of June to the first day of October in each year fish with hauling seine or drag-net of any kind within the Chesapeake Bay, or any of its tributaries lying northward of the following line, viz: Beginning at Still Pond, in Kent County, and drawn westward to Lego's Point, in Harford County.

Penalty for violation.

Declared forfeited.

SEC. 2. *And be it enacted*, That any person or persons violating any of the provisions of this act, upon conviction thereof before any Justice of the Peace of the county in which said act has been violated, shall pay a fine of fifty dollars, one-half of which shall go to the informer, and any hauling seine or hauling seines, drag-net or drag-nets, and the boat or boats and material used in fishing the same are hereby declared to be forfeited, and the Justice or Justices before whom said conviction and condemnation shall be had, is authorized and directed to have said fishing apparatus sold by the sheriff or constable making said arrest to the highest bidder, and the proceeds, together with half the fine, after deducting the cost, shall be paid to the County Commissioners of the county in which said offence shall be committed, for the use of the school fund of said county.

SEC. 3. *And be it enacted,* That any person or persons, on conviction, failing to pay the fine as prescribed in the preceding section, shall be imprisoned in the county jail of the county in which said offence shall be committed; provided, however, that any one so offending shall, upon conviction before any Justice of the Peace of the county in which said offence shall be committed, have the right of appeal to the Circuit Court of the county in which said offence shall be committed, under the same restrictions governing appeals from the decisions of Justices of the Peace.

Right of appeal.

SEC. 2. *And be it enacted,* That this act shall take effect from the date of its passage.

Effective.

Chapter 354, *Laws* 1880, *repeals Section* 10, *of Article* 41, *Code Public General Laws, title Fish and Fisheries, and re-enacts the same, as follows:*

SEC. 10. No float or other device for fishing shall be anchored or located at any place, so as to interfere with any shore fishery now used as such, or which may be hereafter established; nor shall any seine be hauled from such floats or other device over the ground usually hauled over by any shore fishery; nor shall any float haul over the grounds usually hauled over by another float, which has cleared its haul and been located in the same position two or more fishing seasons, unless the said float shall abandon for one spring the locality previously occupied; and any person or persons violating this section shall, for each offence, pay a fine of not less than twenty-five dollars nor more than one hundred dollars; and for every hour such float or other device shall remain anchored or located, after notice shall be given by the owner or occupant of such shore, float or fishery, requiring him to remove, he shall pay an additional fine of not less than ten dollars nor more than twenty-five dollars.

Not to interfere.

Penalty for violation.

PUBLIC LOCAL LAWS.

BALTIMORE COUNTY.

Chapter 95, *Laws* 1880, *protects fish in Middle River.*

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall not be lawful for any person or persons to take any fish in Middle River and its tributary streams, or in the waters of the Chesapeake Bay within one mile of the entrance into the said Middle River, bounding on or lying within Baltimore county, by means of any seines or nets whatsoever.

Unlawful to catch fish.

SEC. 2. *And be it enacted*, That it shall not be lawful for any person or persons to fish in said waters with nets fastened to stakes, commonly known as pound, fyke or trap nets.

Use of nets, &c., prohibited.

SEC. 3. *And be it enacted*, That upon information given upon oath or affirmation to any Justice of the Peace having jurisdiction of any violation of any of the provisions of this act, he shall issue his warrant for the arrest of the offender or offenders, and for the seizure of the seines, nets, boats and other fishing outfit, to be directed to the sheriff or any constable of the county or other officer authorized to make arrests, or citizens, upon the receipt of said warrant to arrest any person or persons violating the provisions of this act, and to seize any such seine, net, boat or other fishing outfit, and found being used in violating any of said provisions, and to bring such offender or offenders before a Justice of the Peace most accessible or convenient, and upon conviction thereof the said offender or offenders shall be fined not less than twenty dollars nor more than two hundred dollars, one-half of such fine to be

Issue warrant for violation.

Violation—fine for.

paid to the use of the informer, and the other half to the use of the public schools of the county in which said offence was committed, and shall forfeit the seine, net, boat and other outfit used in such fishing, which shall be sold and the proceeds divided in such manner, and in case of non-payment of the fine and costs imposed by said Justice, the said offender or offenders shall be confined in the county jail for a period not exceeding forty days and not less than twenty days, or until said fine and costs are paid.

Right of appeal.

SEC. 4. *And be it enacted*, That any person or persons who may feel himself or themselves aggrieved by any judgment rendered by a Justice of the Peace under the provisions of this act, shall have the right to appeal to the Circuit Court of Baltimore county, upon condition and subject to the regulations now provided by the general law regulating appeals from Justices of the Peace, but execution of the judgment of the Justice of the Peace shall not be stayed, unless the party appealing shall give bond to the State in double the amount of fine imposed, with security approved by the Justice rendering the judgment, with conditions to prosecute his appeal with effect or to pay the fine imposed with all costs.

Effective.

SEC. 5. *And be it enacted*, That this act shall take effect from the date of its passage.

CALVERT COUNTY.

Chapter 179, *Laws* 1880, *protects fish in the waters of Battle, Hunting and St. Leonard's Creeks, Calvert County.*

Who are allowed to haul seine.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That none but citizens of Calvert county shall, for any purpose whatsoever, haul a seine or seines, or any other instrument, in the waters of Battle creek, Hunting creek or St. Leonard's creek, in said county.

SEC. 2. *And be it enacted*, That no person whatsoever shall haul a seine or seines, or any other instrument, in said waters of Battle creek, or use Hunting creek or St. Leonard's creek for the purpose of catching fish for sale, or for any other purpose than for home consumption.

Catching for sale prohibited.

SEC. 3. *And be it enacted*, That any person or persons violating either of the above sections of this act shall be deemed guilty of a misdemeanor, and upon conviction before a Justice of the Peace shall be fined not less than ten nor more than fifty dollars, one-half to be paid to the informer and the other half to the County Commissioners of Calvert county, for county purposes; and that either the State or the defendant shall have the same right of appeal from the judgments of said Justices as is now allowed in civil cases.

Penalty for violation.

SEC. 4. *And be it enacted*, That the boat and seine used by any person or persons violating either of the above sections of this act shall be responsible for the aforesaid fine.

Who is responsible.

SEC. 5. *And be it enacted*, That this act shall take effect from the date of its passage.

Effective.

CARROLL COUNTY.

Chapter 425, *Laws* 1880, *protects fish in waters of Carroll and Frederick Counties.*

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall be unlawful for any person or persons to take, catch or destroy any fish in the waters of Frederick or Carroll counties except with hook and line, or by use of the dip net; provided that the Potomac river shall be exempted from the provisions of this act.

When unlawful.

SEC. 2. *And be it enacted*, That any one violating the provisions of the preceding section shall, upon conviction before a Justice of the Peace of said counties, be liable to a fine of

Fine for violation.

not less than five dollars nor more than ten dollars, for each offence, and upon failing to pay such fine and cost of prosecution shall be sentenced to imprisonment in the county jail of the county in which the offence has been committed for a period not exceeding ten days, said fine to be paid to the County Commissioners for the use of the county; provided, however, that any person so convicted shall have the right of appeal to the next term of the county court.

CECIL COUNTY.

Chapter 27, *Laws* 1880, *repeals Chapter* 449, *Laws* 1878, *and enacts the following in lieu thereof:*

Not lawful to lash or beat the waters.

Consent to be obtained.

1. It shall not be lawful for any person to lash or beat the waters of the Elk and Bohemia rivers with rods, poles or sticks, or any other instrument, or to make noises on the decks of any boat or any part of said boat for the purpose of driving fish into any net or seine within a half mile of Plum, Locust, Henderson's, Rich Neck, Welsh, Lorts or Oldfield's points on Heron island on the Elk river, or Town, Rich, Parlor, Long, Hackett's or George's point on the Bohemia river, when said points and island are occupied by persons engaged in gunning for wild fowl with decoys in the water nor within a half mile of the bridge over the Bohemia river when occupied by persons gunning for wild fowl from said bridge, unless the consent of such persons is first obtained to such fishing as aforesaid. Nor shall it be lawful to fish as aforesaid on the waters of the Elk and Bohemia rivers from the first day of April to the first day of September of each year.

Fines — how recovered.

2. Any person violating any of the provisions of this act shall, upon arrest and conviction thereof before a Justice of the Peace in and for Cecil county, be fined not less than ten nor more than twenty-five dollars, to be recovered as other small debts are recovered. And all

fines imposed under this act shall be divided as follows: one-half to the officer making the arrest, and the other half to the County Commissioners of Cecil county, to be applied by them to the use and benefit of said county.

Fines — how disposed of.

SEC. 2. *And be it enacted*, That this act shall take effect from the date of its passage.

Effective.

Chapter 197, *Laws* 1880, *repeals Section* 1, *Chapter* 134, *Laws* 1876, *and re-enact the same with amendments.*

1. On and after the passage of this act it shall be lawful for any owner, or owners, of land bordering upon the waters of the Elk, Sassafras and Bohemia rivers, and their tributaries, lying and being within the limits of Cecil county, or to whomsoever they may extend the privilege, to take or catch fish from nets or traps known as pound nets, except from the first day of June to the fifteenth day of September of each year; provided that such pound nets shall not extend to or across any channel, nor shall they be so placed as to, in anywise, obstruct the passage of any vessel or boat engaged in trading in said waters; nor shall any seine or net be used in that portion of said pound nets that confines the fish, the meshes of which are less than one and a quarter inches square; nor shall any stake or post be used in placing said pound nets of a greater diameter than four inches in the largest part; nor shall such stake or post be permitted to remain in said waters for a longer period than that prescribed in this act for the placing of said pound nets.

When lawful

Size of meshes.

SEC. 2. *And be it enacted*, That this act shall take effect from its passage.

Effective.

CHESTER RIVER.

Chapter 114, *Laws* 1880, *regulates catching fish in Chester River and its tributaries in Kent and Queen Anne Counties.*

Section 1. *Be it enacted by the General Assembly of Maryland*, That it shall not be lawful for any person or persons to take, capture or destroy fish in the waters of Chester River or its tributaries in Kent and Queen Anne counties, by seines, drag-nets, set-nets, fish-baskets, fish-pots, weirs, pound-nets, fykes or any other means or contrivance whatsoever, which is now known or used in the capturing or destroying fish, or which may hereafter be invented for that purpose, from the tenth day of May to the first day of September, except with hook and line; provided, however, that seines or nets may be used for the taking of taylors and mackerel fish, provided the meshes of such nets or seines are in the bar not less than one and seven-eighth inches, or in the mesh less than three and three-quarter inches.

Unlawful to capture fish.

Sec. 2. *And be it enacted*, That it shall not be lawful for any person or persons who use stakes or poles in setting nets of whatever class or description, in the waters mentioned in the first section of this act, to leave such stakes or poles in the waters where they were used, but shall remove, or have removed, such stakes or poles from the waters where they were used, on or before the twentieth day of May in each year, nor shall they again be put down in said waters prior to the twentieth day of September following.

Unlawful to leave stakes in water.

Sec. 3. *And be it enacted*, That for any person or persons, in said waters, in the first section of this act, to empty their seines upon the beach or shore at any time whilst engaged in fishing, so as to leave the smaller fish to perish, but to empty the same in water of sufficient depth to enable the smaller fish to return to the waters for growth and maturation, and any person or persons using seines, pound-nets, fish-baskets, fykes, traps or nets of any class or description that catch the fish alive, shall immediately cull them and return the small fish to the waters at the place where they were taken.

Not to empty seines on the shore.

Sec. 4. *And be it enacted*, That no person or persons, other than the bona fide residents of Kent and Queen Anne counties, shall use any boat or trap of any kind or description used in catching fish in the said waters of Chester River and its tributaries in said counties; provided, however, that persons owning or occupying lands in said counties on said river and its tributaries, shall have the right to rent or otherwise grant to non-residents the privilege of fishing in or opposite their shores during the fishing season hereinbefore limited and fixed; and further provided, that the right to take fish with hook and line shall be allowed to all persons at all times.

Not to use boat or trap.

Sec. 5. *And be it enacted*, That upon the information of any citizen of either of said counties, that he knows or verily believes that any person or persons have violated any of the provisions of this act, before any Justice of the Peace of either of said counties, the said Justice of the Peace shall docket a case in the name of the State of Maryland against such person or persons so charged by oath as offending, and issue a warrant at once to some one of the constables or the sheriff of such county, for the arrest of the party or parties charged in said oath with such violation of this act, to be brought before such Justice for trial, and said constable or sheriff shall seize the boat, tackle, nets and other equipments owned by or in the possession of such person or persons so charged with the violation of this act, when such violation occurred, or at the time of such arrest, and safely keep such property so taken during the time pending the trial for such offence so charged, and if upon such trial the Justice of the Peace shall enter judgment for the State, such person or persons as against whom such judgment shall be rendered shall be fined not less than twenty nor more than fifty dollars for each and every offence, in the discretion of said Justice of the Peace; one-half of which fine shall be paid to the informer, the other

Docket case.

Seize boat, tackle, &c.

Fine for violation.

half to the school fund of the county where such judgment is rendered, and if such fine is not paid within five days from the date of said judgment, the said Justice of the Peace shall, on the sixth day thereafter, enter judgment of condemnation against the boat, tackle, nets, or other equipments of such offender which had been seized by the officer aforesaid, which said boat, tackle, nets or other equipments shall, after ten days' notice, be, by the said officer, sold to the highest bidder for cash, and from the proceeds of such sale shall deduct the fees allowed constables upon executions, the costs incident to such trial and judgment, together with such expense as such officer may have incurred in the taking and keeping of such property, and shall then divide the residue between the informer and the schools of the county equally, said officer not to be liable for any damage or loss of said property while in his custody which may occur without fault on his part.

Enter judgment.

How disposed of.

SEC. 6. *And be it enacted*, That if any person or persons convicted of offending against any of the provisions of this act shall think himself aggrieved by such conviction, he or they may appeal from the judgment of the Justice of the Peace before whom such conviction is had, at any time within ten days from the rendition thereof, to the Circuit Court of the county in which the trial was had. If any resistance be made to the officer directed to execute this act by any person or persons offending against the same, the said officer shall summon the posse comitatus and proceed therewith without delay to execute his duty under such warrant. The Justice before whom such offender or offenders shall be taken shall have full power to issue summons for all witnesses that be named to him, to compel their appearance and examine them under oath.

Right of appeal.

SEC. 7. *And be it enacted*, That all acts or parts of acts inconsistent with this act be and the same are hereby repealed, and that this act shall take effect from the date of its passage.

Inconsistent acts repealed.

FREDERICK COUNTY.

See Carroll County.

HARFORD COUNTY.

Chapter 194, *Laws* 1880, *repeals Section* 1, *Chapter* 41, *Laws* 1867, *and re-enact as follows:*

Unlawful to whip or beat waters.

SEC. 2. *And be it enacted*, That it shall not be lawful for any person to whip or beat the waters of Romney creek, in Harford county, with poles, sticks, or any other thing for the purpose of driving fish into seines, fish baskets, or any other contrivance for catching fish; nor shall it be lawful for any person, at any time, to do said acts, or any other thing for the purpose, or which will have the effect of frightening or driving wild ducks or other wild waterfowl from their feeding or roosting grounds in said creek; nor shall it be lawful for any person, at any time, between the first day of October and the fifteenth day of March, in each and every year, to erect any fish pot, or to fish with any drag net, fish basket, or any other snare, for fish, in the waters of said creek.

KENT COUNTY.

See Chester River.

PATAPSCO RIVER.

Chapter 76, *Laws* 1880, *repeals Section* 1, *Chapter* 79, *Laws* 1874, *and re-enacts the same with amendment, as follows:*

Unlawful to capture fish by seines, &c.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That from and after the passage of this act it shall not be lawful for any person or persons to take, capture or destroy fish by seine or seines, drag-net or drag-nets, set-net or set-nets, dip-net or dip-nets, stir-net or stir-nets, fish baskets or fish pots, eels weirs, brush or fascine nets, or any means or contrivances whatever of the nature of a seine, which are known to destroy or capture fish, or to destroy or capture them by shooting or striking through the ice, or otherwise, than by hook and line, commonly known as angling, in the Patapsco river, above the point where the old turnpike road from Baltimore to Washington crosses the said river.

Effective.

SEC. 2. *And be it enacted*, That this act shall take effect from the date of its passage.

QUEEN ANNE COUNTY.

See Chester River.

SOMERSET COUNTY.

Chapter 379, *Laws* 1880, *prevents catching fish except in certain cases in Coulbourn's Creek.*

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall be unlawful for any person to take or catch, or destroy, in any manner whatever, fish in the waters of Coulburn's creek, in Somerset county, with any kind of seine, net or weir, except such nets as are used for catching rock fish, during the months of March, April and May, which said last mentioned net shall not exceed in length twenty fathoms; but nothing herein shall be construed to prevent fishing with hook and line.

Unlawful.

SEC. 2. *And be it enacted*, That any person or persons who may violate the provisions of this act shall, upon conviction thereof before any Justice of the Peace for said county, be fined for each and every offence the sum of twenty dollars, and to stand committed in the county jail until the fine and costs are paid.

Fine for violation.

SEC. 3. *And be it enacted*, That any person feeling aggrieved by any decision under the provisions of this act shall have the right to appeal to the Circuit Court for said county.

Right of appeal.

SEC. 4. *And be it enacted*, That this act shall take effect from the date of its passage.

Effective.

WASHINGTON COUNTY.

Chapter 322, *Laws* 1880, *repeals Sections* 102 *and* 103, *Code Public Local Laws, title Washington County, sub-title Fish, and re-enacts as follows:*

102. It shall not be lawful for any person to whip or beat the water in the Antietam creek or its tributary streams, Beaver creek, Long Meadow branch and Little Antietam, with poles, sticks or other things, for the purpose of driving the fish into nets, seines, fish baskets or other snares, or to erect any fish pot, or to fish with any net, basket, gig, trot line, or in any other manner, except with the angling rod and dip-nets.

Unlawful acts.

103. Any person offending against the provisions of the last preceding section shall be arrested and taken before a Justice of the Peace, and on conviction, shall forfeit and pay for each offence, and for each month a fish pot may be suffered to remain in any of the streams aforesaid, a fine, not exceeding the sum of twenty dollars, and in default of payment of such fine shall be committed to the county jail for a term not exceeding sixty days, the said fine to be recovered in the name of the County Commissioners of Washington county, before a Justice of the Peace, one-half to be paid to the informer and the other half to the school fund of said county; provided that any person feeling himself aggrieved by the judgment rendered by any Justice of the Peace, in proceedings under the provision of this and the last preceding section, shall have the right to appeal from said judgment to the Circuit Court for Washington county.

Fine for violation.

SEC. 2. *And be it enacted*, That this act shall take effect from the date of its passage.

Effective.

WICOMICO COUNTY.

Chapter 448, *Laws* 1880, *protects fish in waters of Wicomico County.*

Unlawful to use pound net, &c.

SECTION 1. *Be it enacted by the General Assembly of Maryland,* That it shall be unlawful for any person or persons to set, stake, or in any manner place any pound net or fyke net made of twine, in the waters of Wicomico county, at any time.

Not to catch, capture, &c.

SEC. 2. *And be it enacted,* That it shall be unlawful for any person or persons to catch, take, capture, kill or injure any shad, herring, rock, perch or any other kind of fish with haul seine, float seine, stake seine, or any other kind of seine, net or fish trap in the waters of said county, between the twentieth day of May in each and every year, and the first day of September in the next succeeding year.

Fine for violation.

SEC. 3. *And be it enacted,* That each and every person who may violate any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof, before any Justice of the Peace of Wicomico county, shall be fined by the said Justice of the Peace sitting in the case a sum not less than ten dollars nor more than twenty-five dollars, for each and every violation aforesaid; and each and every person so convicted and fined shall be committed by the said Justice of the Peace to be confined in the county jail in said county until the said fine and all costs of the prosecution are paid; and shall, in addition to the said penalties, also forfeit and lose all seines, nets and boats of every kind which may be used by them in violating as aforesaid.

Sell forfeited property.

SEC. 4. *And be it enacted,* That it shall be the duty of the Justice of the Peace to decree the forfeiture mentioned in the preceding section, and to order and direct the constable or other officer making the arrest, to take and sell any property so forfeited as aforesaid, after first giving at least ten days' notice by advertisement inserted in some newspaper published in said county, or by advertisement posted in three of the most public places in the neighborhood in which the offender may live, of the time and place of sale, and the said sale shall be for cash; and after deducting all costs and charges of advertising and making said sale, the balance of the proceeds of said sale shall be equally divided, and one-half thereof shall be paid by the officer collecting the same to the informer, and the other half shall be paid by said officer to the treasurer of the school board, for the use and benefit of the public schools in said county.

Right of appeal.

SEC. 5. *And be it enacted*, That any person or persons feeling aggrieved by the decision of the Justice of the Peace made and given under the provisions of this act, shall have the right to appeal to the Circuit Court for said county, and shall be notified of the said right of appeal, by the said Justice of the Peace, at the conclusion of the proceedings before him; provided, however, that no appeal shall be granted as aforesaid, unless the person so appealing shall first, within ten days after the entering of the judgment of the said Justice of the Peace, give a full and sufficient bond, with two good and responsible sureties, to be approved by the said Justice of the Peace to the State of Maryland, with condition to prosecute said appeal to the said Circuit Court at its next session thereafter, and also to pay the fine already imposed, together with all the costs, both before the Justice of the Peace and the Circuit Court, in the event the said judgment shall be affirmed.

Issue warrant for arrest.

SEC. 6. *And be it enacted*, That on information being given on oath to a Justice of the Peace of said county that a violation of any of the provisions of this act has been, or is being committed by any person or persons, the said Justice of the Peace shall forthwith issue his warrant, in the name of the State of Maryland, for the arrest of the offender or offenders, which warrant shall be directed to the sheriff or some constable or baliff in said county, and the officer receiving said warrant may summon the posse comitatus, when necessary, to aid him in making any arrest under this act.

How construed.

SEC. 7. *And be it enacted*, That nothing in this act shall be so construed as to prevent any of the citizens of Wicomico county from catching or trapping fish in any of the waters of said county, for private use, at any time of the year.

Effective.

SEC. 8. *And be it enacted*, That all acts and parts of acts inconsistent with the provisions of this act be and the same are hereby repealed, and that this act shall take effect from the date of its passage.

WORCESTER COUNTY.

Chapter 223, *Laws* 1880, *regulates fishing in Synepuxent Bay.*

Unlawful to set seines, &c.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That it shall be unlawful for any person or persons to place any set seine or seines, or any seines or nets in any manner rendered stationary, in that part of the waters of Synepuxent bay, north of South Point, Isle of Wight bay, Assawoman bay and Saint Martin's river, which is located equally at all points on either side of a line drawn through the centre of each of said waters, from the northern to the southern extremity thereof, and extending in width at all points of said line one-third part of the distance which separates the opposite shores of the waters aforesaid, at said points; and all seines or nets used in violation of this act shall be forfeited and sold as hereinafter directed.

Unlawful to haul with seine.

SEC. 2. *And be it enacted*, That it shall be unlawful for any person or persons to haul or fish with any haul or set seine or seines, or to leave or to permit to remain setting, any set seine or seines in any part of the waters of Synepuxent bay and its tributaries, north of South Point, during the interval from the hour of six o'clock P. M. of Saturday of each week until the hour of six o'clock A. M. of the following Monday.

Weight specified.

SEC. 3. *And be it enacted*, That no person shall catch by means of a seine or seines any perch fish of not less than a fourth of a pound each in the waters described in the preceding section.

Fine for violation.

SEC. 4. *And be it enacted*, That any person violating any of the provisions of this act shall be guilty of a misdemeanor, and upon conviction thereof before a Justice of the Peace for Worcester county, or in the Circuit Court of the same county, shall be fined not less than five or more than twenty dollars, and be imprisoned until said fine and all costs in the case are paid; provided said imprisonment shall not exceed thirty days in any event.

Issue warrant.

SEC. 5. *And be it enacted*, That upon information given upon oath to any Justice of the Peace of Worcester county of any violation of any of the provisions of this act, the said Justice shall issue his warrant for the arrest of the offender or offenders, and the seizure of the seine or seines used in violation of this act, which warrant shall be directed to the sheriff or any constable of Worcester county, requiring said offender or offenders to be brought before him, and also all seines used in violating this act, whether the owner of the same be known to him or not.

Sell at auction.

SEC. 6. *And be it enacted*, That it shall be the duty of any Justice of the Peace of the county aforesaid, before whom it shall be proven satisfactorily that any nets or seines have been used in violation of this act, to cause such nets or seines to be sold at public auction to the highest bidder for cash, after giving ten days' notice of the time and place of such sale in at least two public places in the vicinity of said sale, and one-half of all fines collected under this act shall go to the informer, and the other half to the school fund of Worcester county.

TERRAPINS.

Chapter 462, *Laws* 1880, *repeals Section* 2, *Chapter* 424, *Laws* 1878, *and re-enacts the same, as follows :*

Unlawful to catch or take.

SECTION 2. *Be it enacted*, That it shall be unlawful for any person or persons to take or catch from the waters of this State, any diamond back terrapins of a less size than five inches in length upon the bottom shell, at any time, provided that the provisions of this section shall not apply to Worcester and Dorchester counties.

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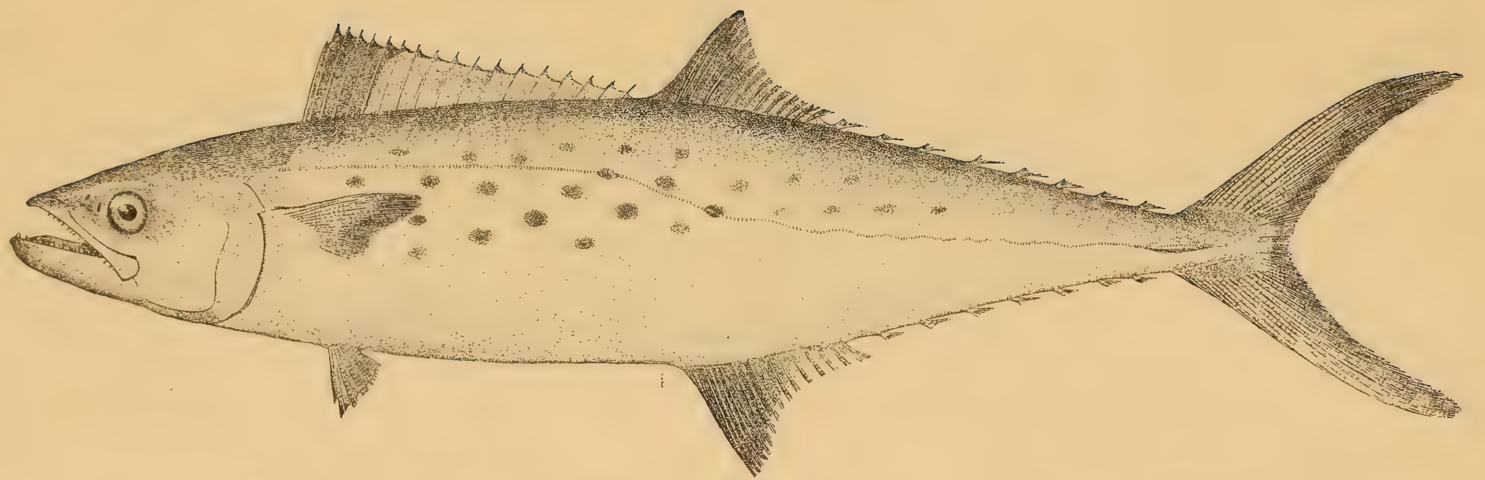

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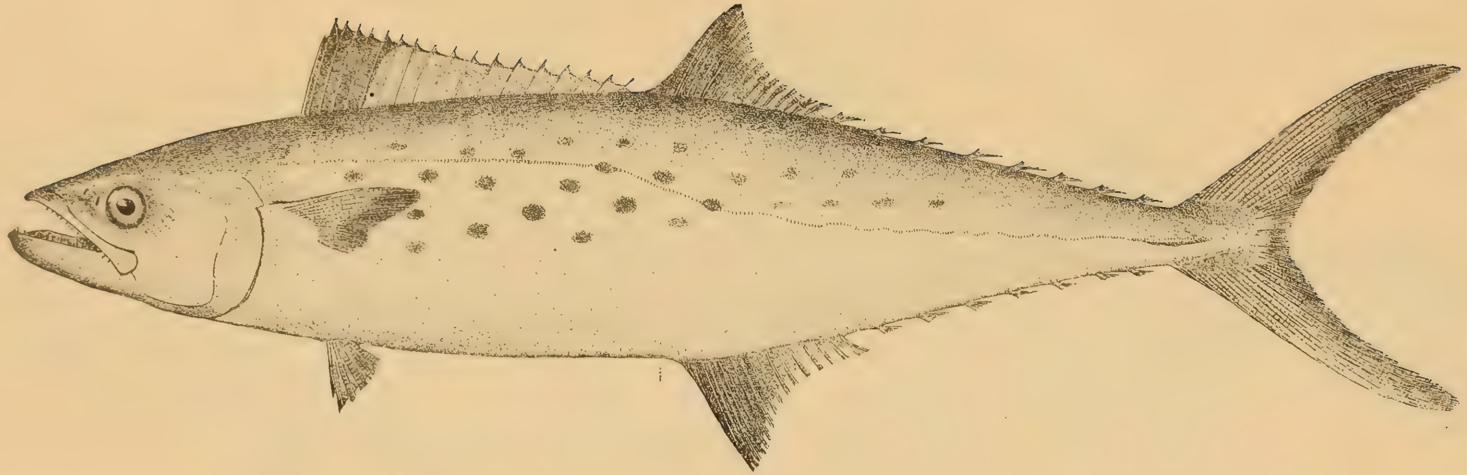

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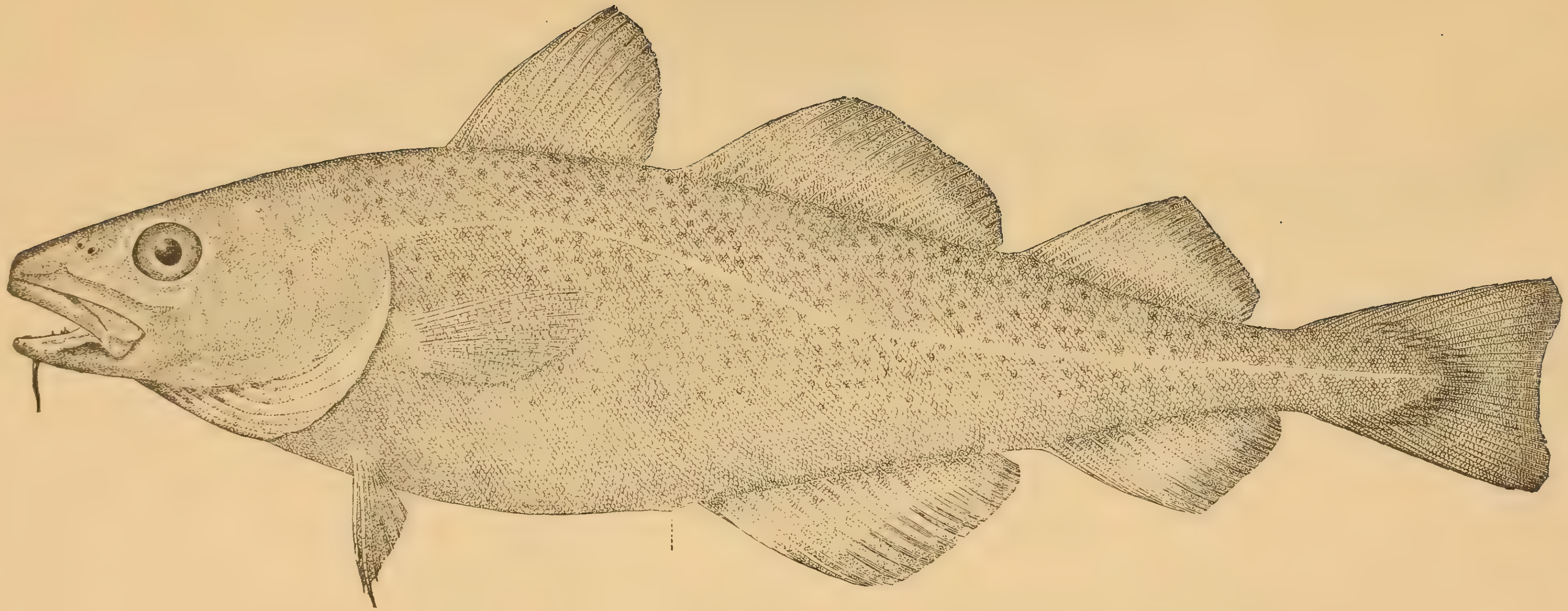

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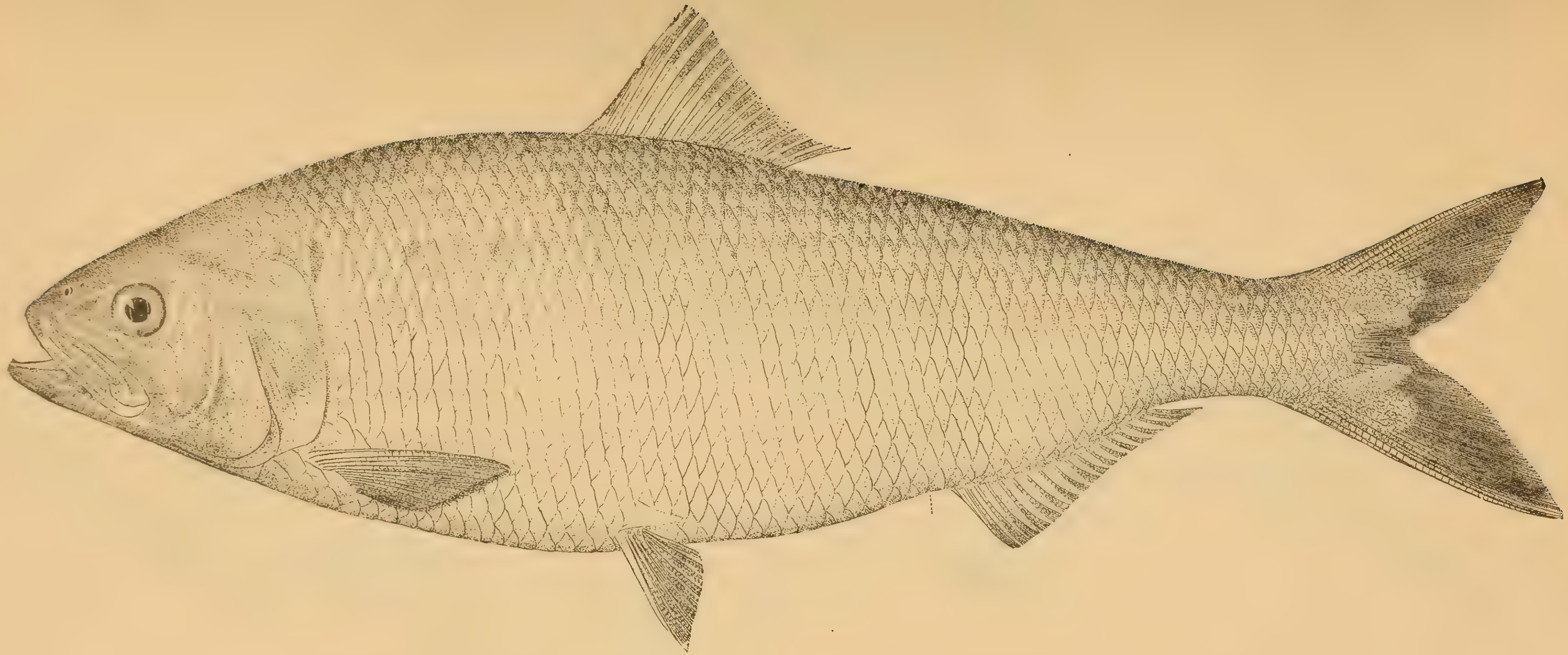

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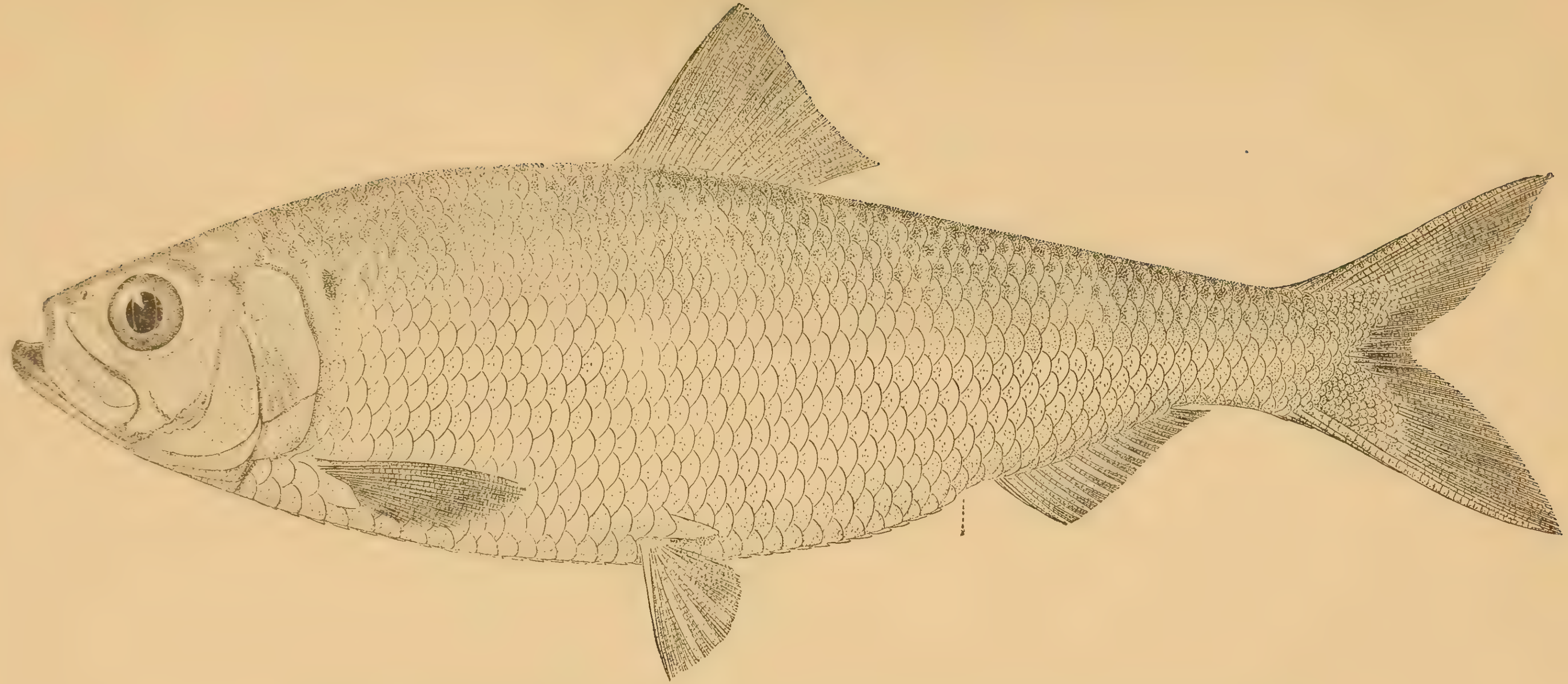

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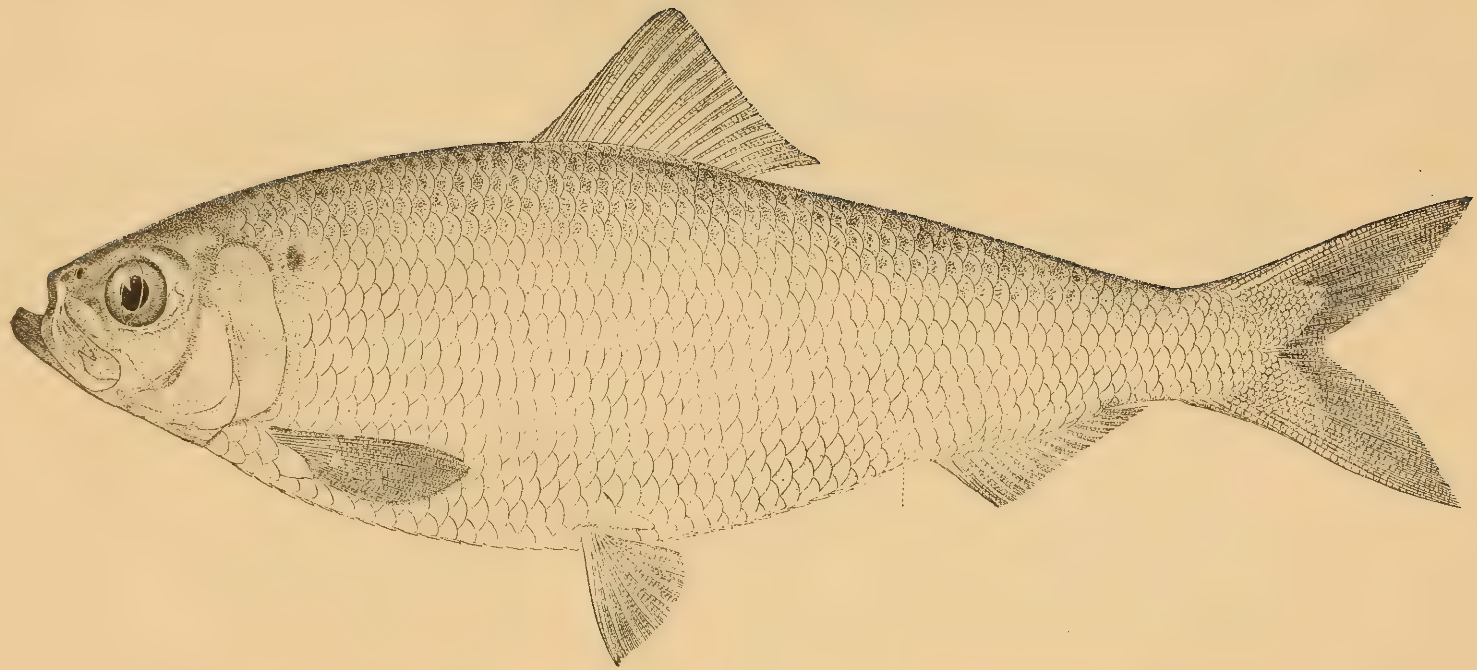

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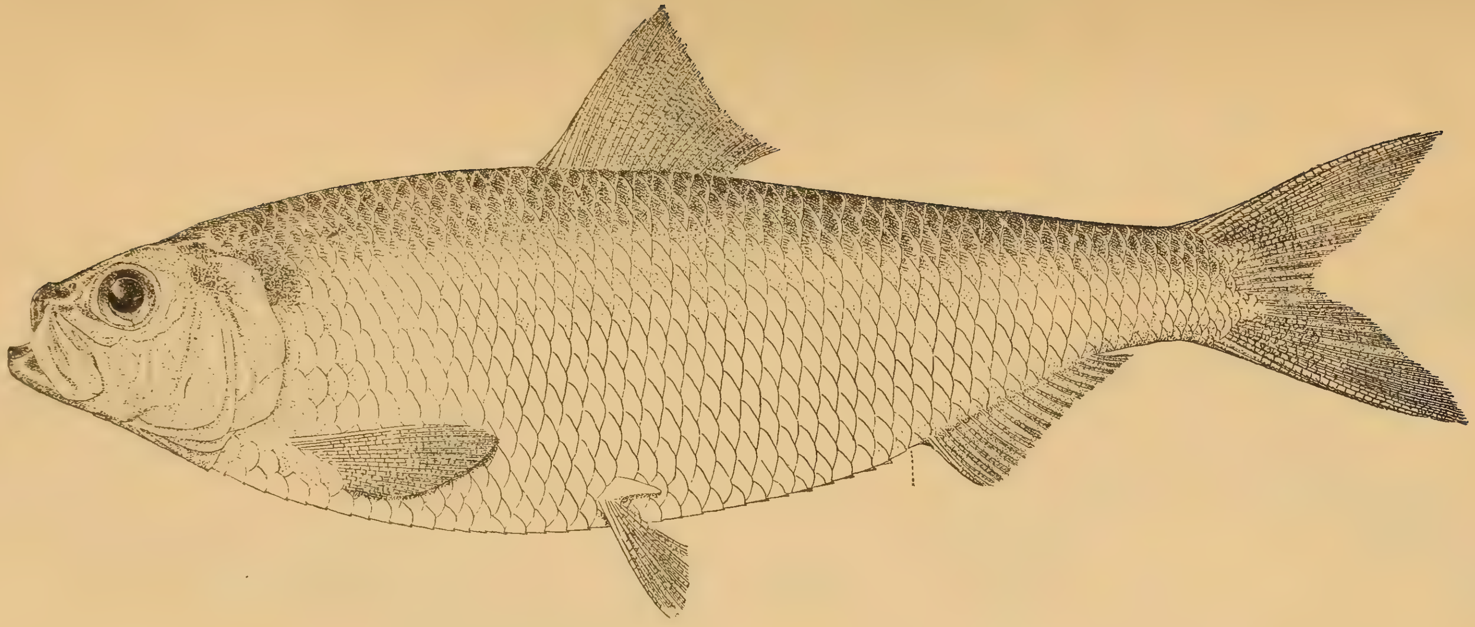
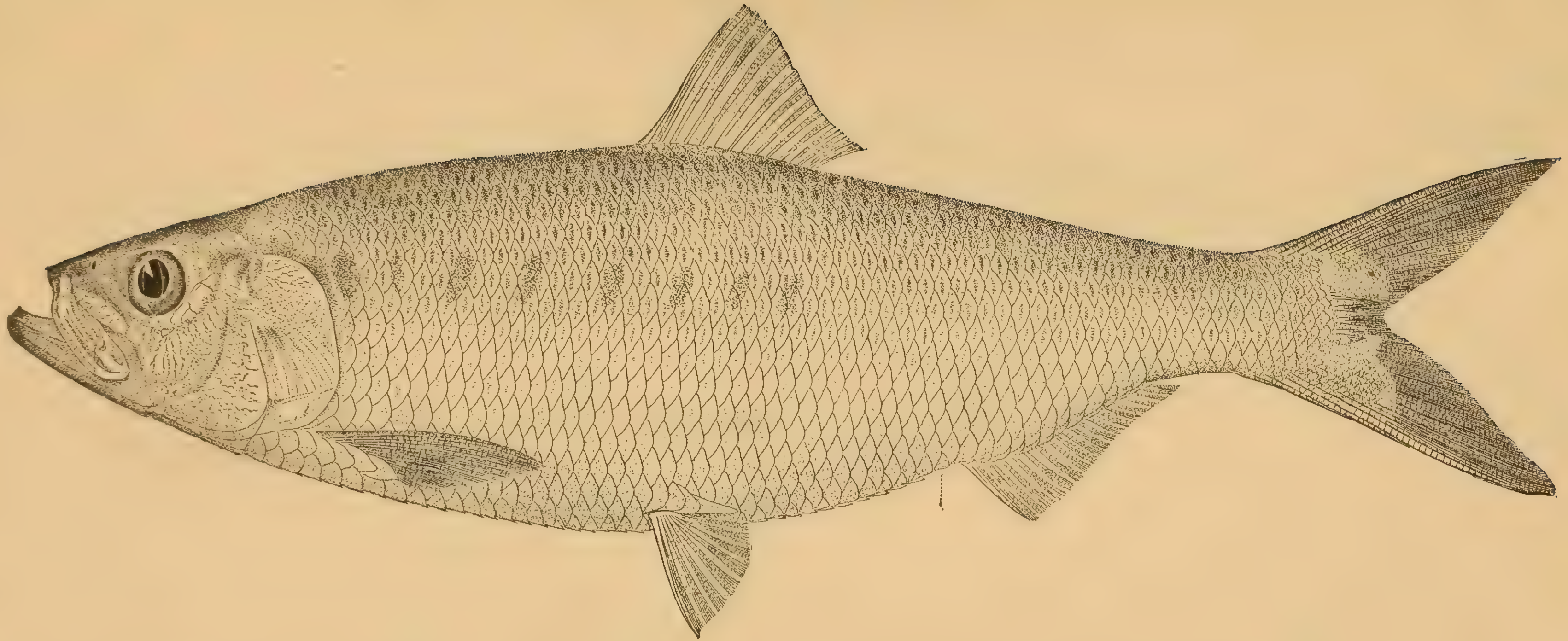
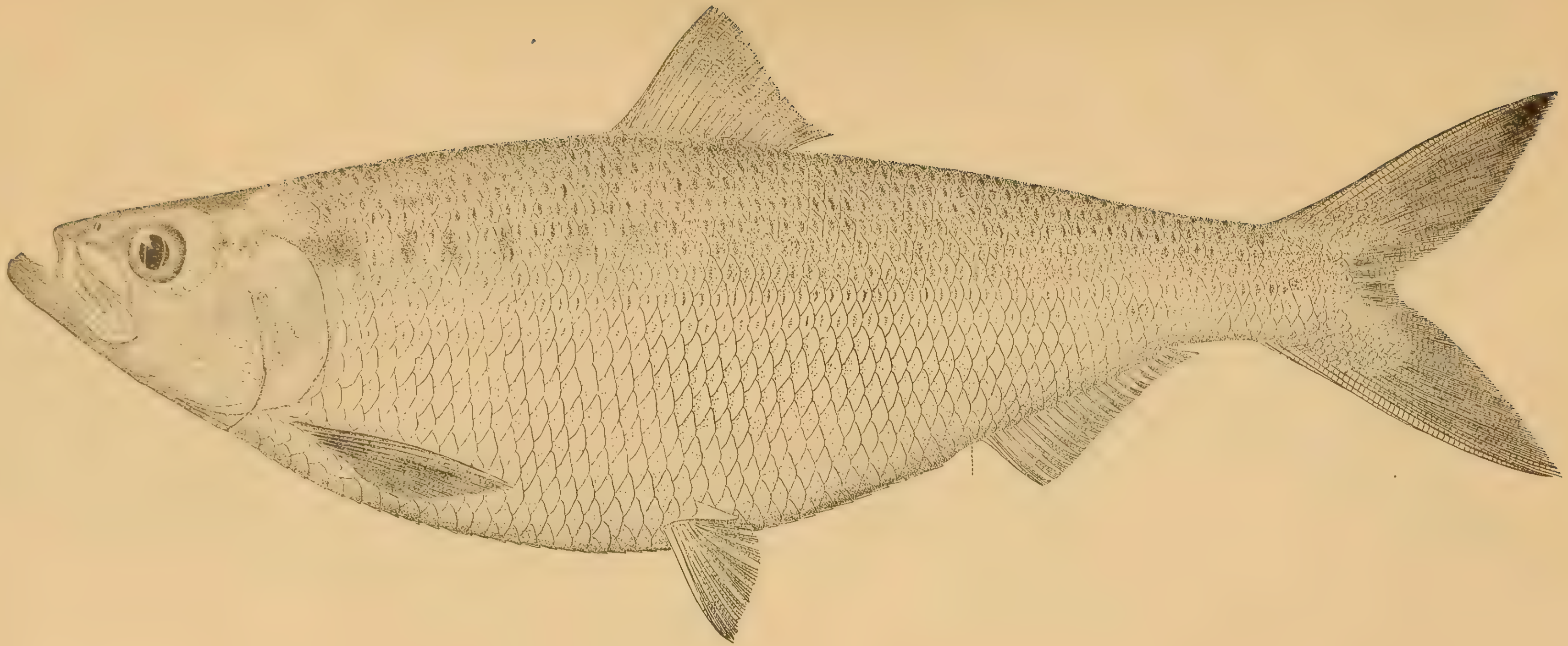


GLUT-HERRING, (½ natural size.) *Pomolobus æstivalis* (male.)



AUTUMNAL HERRING *or* TAILOR SHAD, (a little less than ½ natural size.) *Pomolobus mediocris*, (*male.*)



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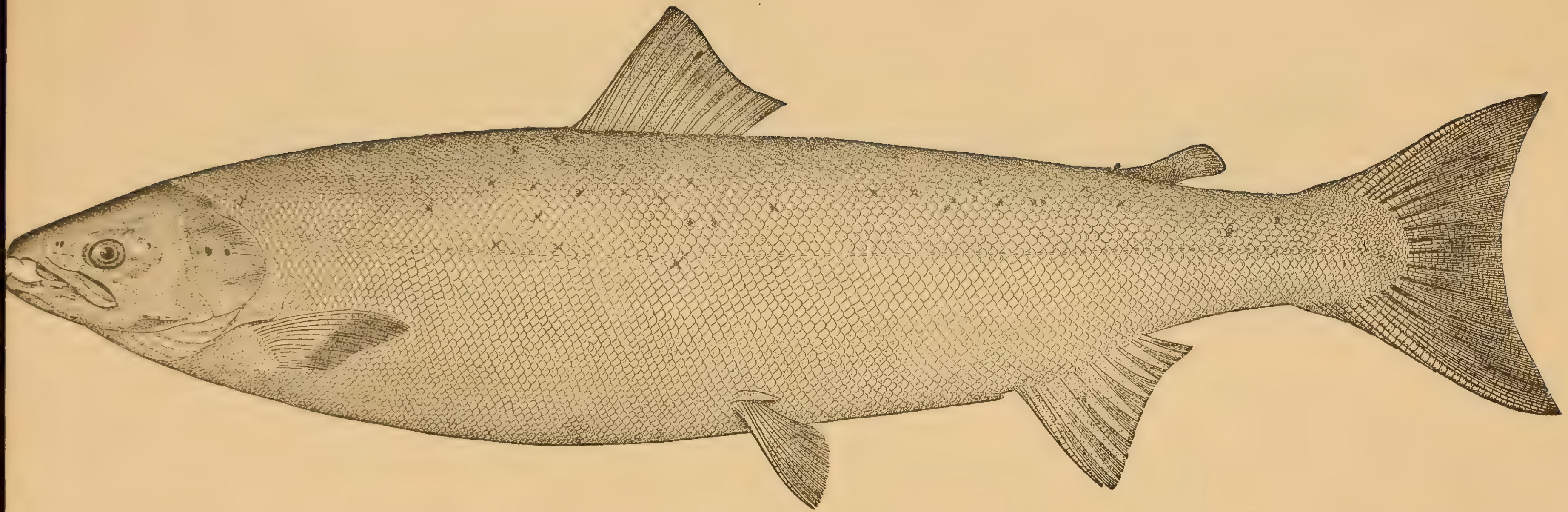
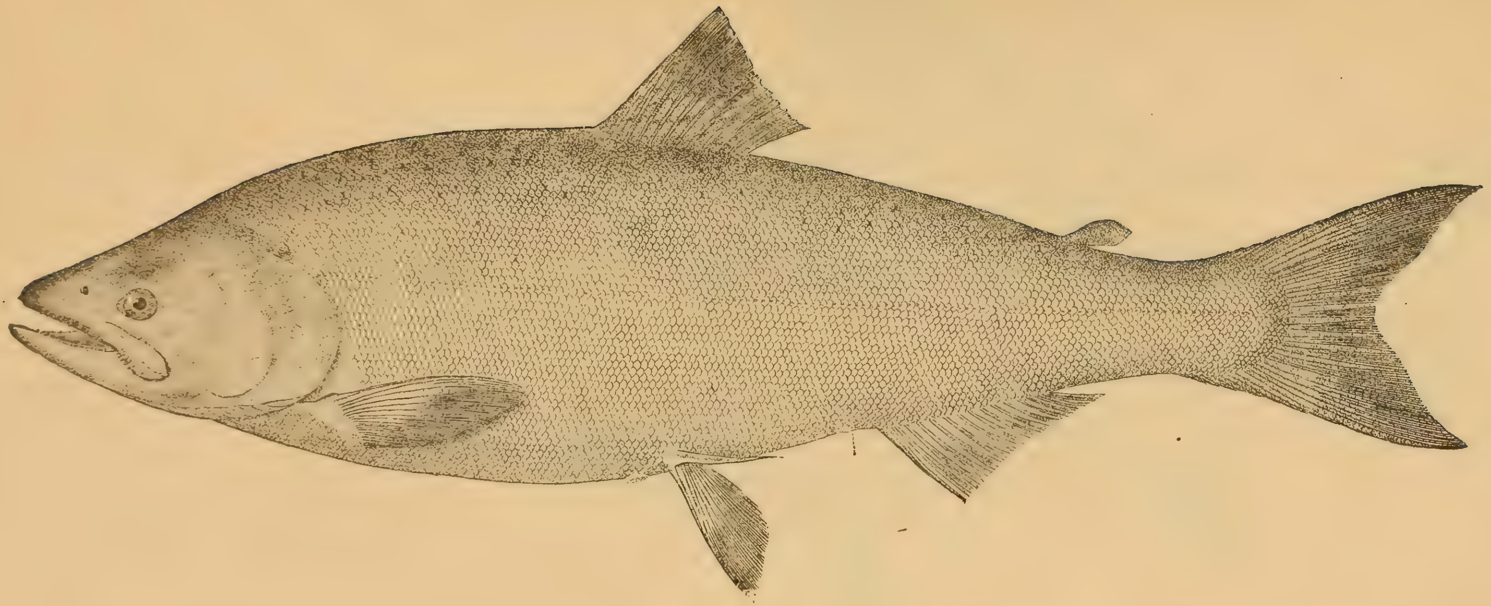
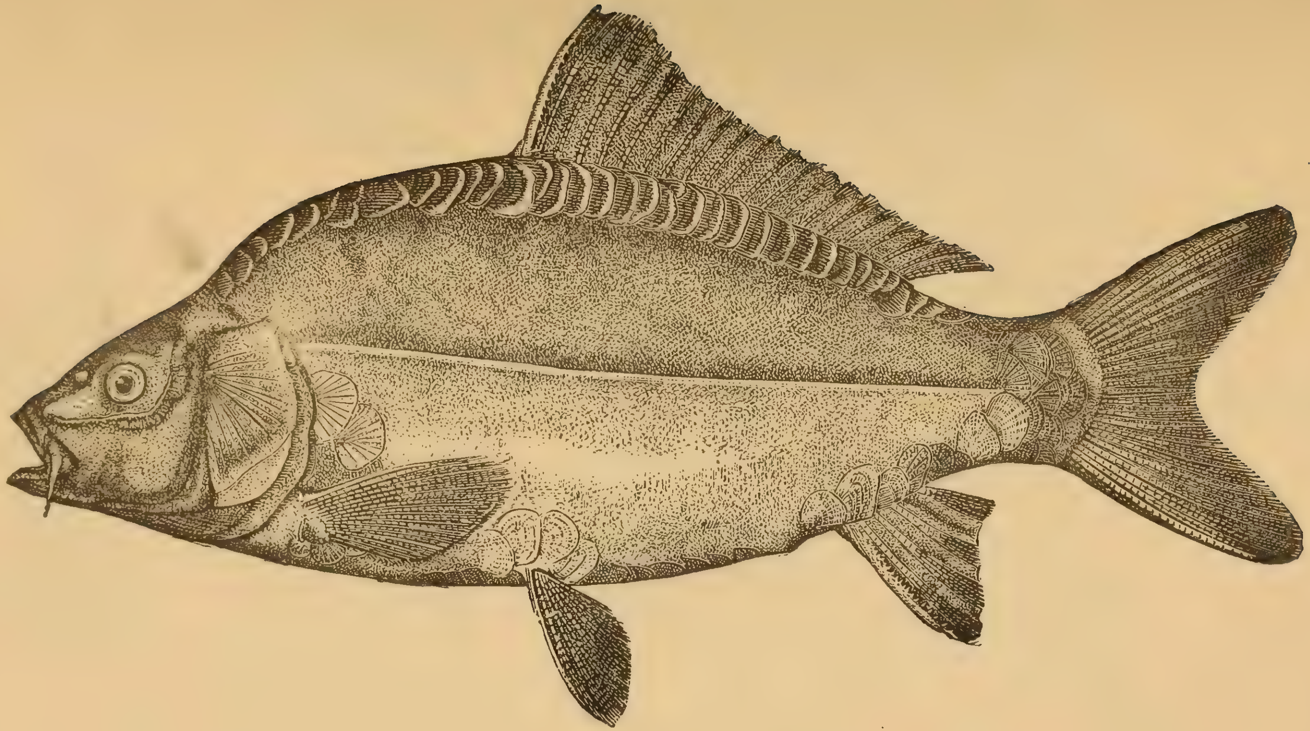


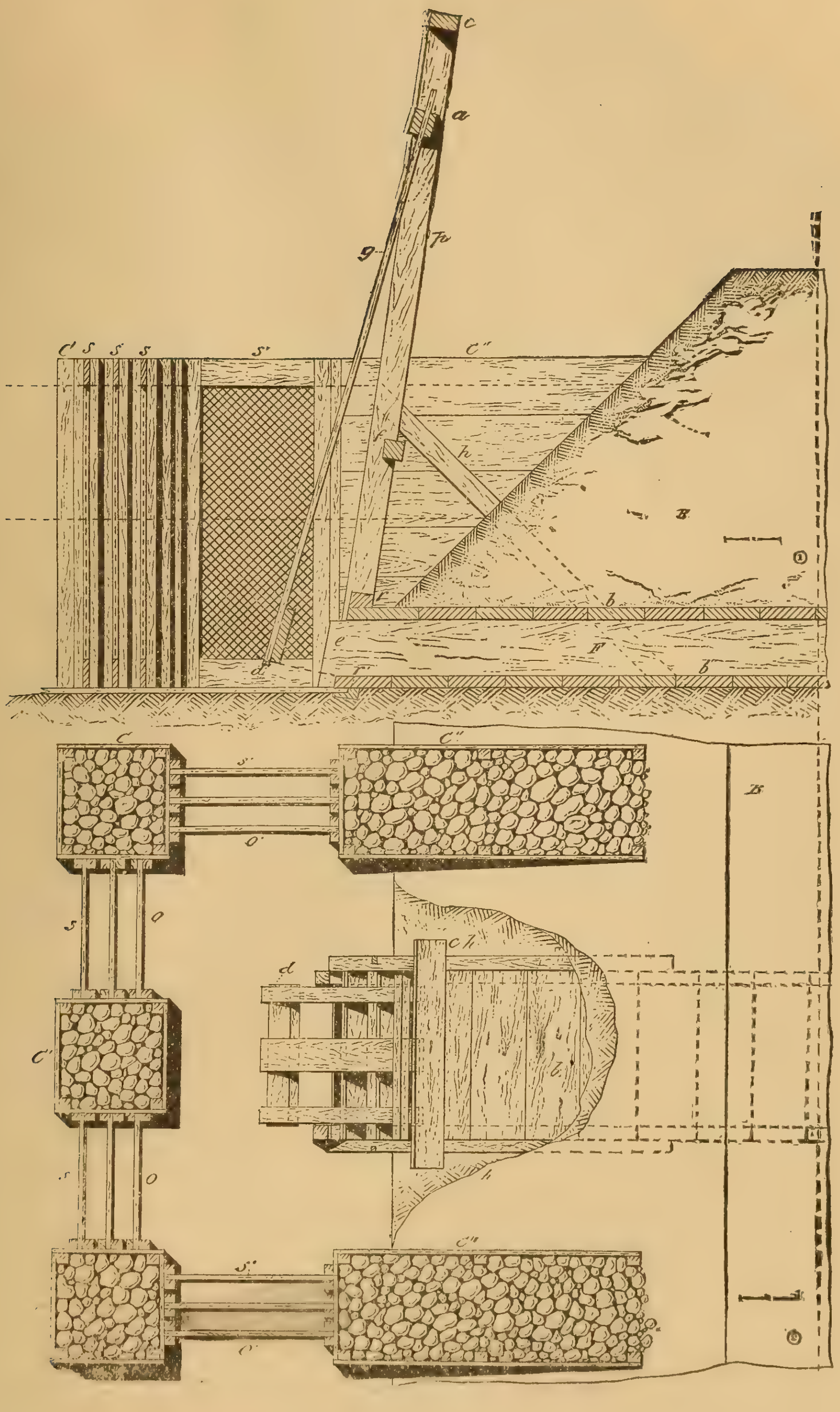
SALMON, Salmo salar, taken near Spesutie Island, Md., on the 11*th of May,* 1878. *Length,* 3′ 4″. *Weight,* 19 *lbs.*



CALIFORNIA SALMON, (1-5 natural size.) *Oncorhynchus quinnat.*



LEATHER CARP, (⅛ natural size.) *Cyprinus Carpio.*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